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AND

COLLECTIONS,

To the End of the Year MDCC.

ABRIDGED,

And diſpoſed under

GENERAL HEADS.

VOLUME II.

Containing all the

PHYSIOLOGICAL PAPERS.

By *JOHN LOWTHORP*, M. A. and F. R. S.

The FIFTH EDITION, Corrected,
In which the LATIN Papers are now firſt tranſlated into ENGLISH.

LONDON:
Printed for W. Innys, R. Ware, J. and P. Knapton, S. Birt, E. Comyns,
D. Browne, T. Longman, H. Whitridge, C. Hitch, J.
Hodges, S. Austen, R. Manby and H. S. Cox, A. Millar,
J. and J. Rivington, and J. Ward.
MDCCXLIX.

LSoc 1816.10.5

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GENERAL HEADS.

CHAP. I.
PHYSIOLOGY.
Meteorology. Pneumaticks.

The new Regulation of the Academie des Sciences at Paris; by M. Geoffroy, n. 257. p. 144.

I. THE *Academie des Stiences* has lately received great Splendour by the Regulations, Encouragement, and Orders, M. *L'Abbé Bignon* has obtained to it from the King. That *Academy* is now compoſed of 10 *Honorary Academicians*, which are choſen, learned and eminent Gentlemen; of 8 *Strangers Aſſociates*, which are diſtinguiſhed by their Learning; 20 *Penſioners* Fellows, 20 *Eleves*, and 20 *French Aſſociates*, who are divided into 6 Claſſes, *viz.* Geometricians, Aſtronomers, Mechanicians, Anatomiſts, Chymiſts, and Botaniſts.

Out of the *Honorary Academicians*, two are elected every Year, one for Preſident, the other for Vice-Preſident: Only 20 *Penſioners* have every Year 1500 *French* Livres; and after the Death of one *Penſioner*, the *Academy* will propoſe to the King 3 Perſons *Aſſociates*, or *Eleves*, or ſometimes others; and his Majeſty will call one of the 3 for *Penſioner*.

The Cauſe of the preſent languid State of Philoſophy, *by M.* Leibnitz. n. 255. p. 273.

II. 1. I know not how it comes to paſs, but the ſublimer Studies are not purſued now ſo much as formerly; whereas after ſo many new Aſſiſtances, they could never be proſecuted to more Advantage. I imagine it is becauſe theſe unhappy Times are come upon us, and the Wars have obliged Mankind to turn

turn their Cares another way, ſo that very few of the younger Perſons are ambitious to attain to the Glory of their Predeceſſors. Even Nature has but few now, that cultivate her diligently. As the *French* Academy of Sciences has been lately new regulated by their King; ſo I wiſh that a new Ardor were infuſed into your Royal Society.

By Dr. J. Wallis, ib. p. 231.

2. What you complain of, that the ſublimer Studies are not purſued now ſo eagerly as formerly, and that Nature now-a-days has not ſo many diligent Obſervers, I confeſs is true in ſome Meaſure: But it is not to be wonder'd at, that as all other Things, ſo the Studies of Men ſhould have their Viciſſitudes. Certain it is that in the preſent Age, which is now drawing to a Period, Knowledge of all Kinds has met with great and even unhoped for Improvements; as Phyſicks, Medicine, Chemiſtry, Anatomy, Botany, Mathematicks, Geometry, Analyticks, Aſtronomy, Geography, Navigation, Mechanicks, and (what I leaſt rejoice at,) the Art of War itſelf: And indeed far greater than for many Ages before. For then Men ſeem'd to aim at nothing farther than to underſtand what had been deliver'd by *Euclid*, *Ariſtotle*, and the reſt of the Ancients, with little Concern about making a farther Progreſs; as tho' the Limits of the Sciences had been fix'd by them, which it was preſumptuous to go beyond. But after ſome few had ventured to look farther, others were encouraged to enter into the wide Field of the Sciences. And a new Ardor, a new Effort urged them to attempt new Things, and not without Succeſs. But when it was no longer a new Thing, this new Ardor wore out. Not a few of the diligent Searchers into Nature are already dead, and others muſt die ſoon: And the Newneſs of the Subject will no longer, as before, excite the young Men to tread in the Steps of their Predeceſſors.

Likewiſe the Matter itſelf was great, which now is partly exhauſted; ſo that a Harveſt is hardly to be hoped for, but only a Gleaning. And it ſeems reaſonable to allow, that thoſe that are tired and wearied ſhould have ſome reſt. And hence it is, as the Nature of Mankind is variable, that ſeverer Studies are neglected. Nay, it may happen (tho' I would not have it ominous,) that the Sloth of the next Age may ſucceed the Induſtry of the preſent.

You wiſh (and ſo do I too) that as the *French* Academy of Sciences now ſeems to be form'd a-new, that a new Ardor may likewiſe be infuſed into our Royal Society. I have admoniſh'd them of this in your Words. But they themſelves (which you will not be ſorry for) had in a Manner prevented my Admonition. For they have lately made ſome new Regulations for themſelves, whereby every Man is to promote ſome particular Inquiry. But there is this Difference between the *French* Academy, and our Royal Society; They are at the King's Expence, and every one enjoys his Salary; whereas ours do all at their own Expence.

A deep Cave in the Obſervatory *at* Paris; *by* M--- n. 74. p. 2217

III. In the Royal Obſervatory at *Paris*, there is, beſides many other Rooms fit for Philoſophical Uſes and Purpoſes, a very deep Cave, having 170 Steps of Deſcent; wherein many Sorts of Experiments are intended to be made, being of that Nature, that they require to be remote from the *Sun-beams* and the open Air; ſuch as are *Thermometrical* ones, and ſuch as concern *Refrigerations*, *Coagulations*, *Indurations*, and *Conſervations* of *Bodies*, &c.

IV.

Barometers, and Obſervations made with them. n. 9. p. 153.

IV. 1. The Barometer or Baroſcope was firſt made publick by that noble Searcher of Nature, Mr. *Boyle*, and employed by him and others, to detect all the minute Variations in the Preſſure and Weight of Air. With this Inſtrument he made divers Obſervations in the Year 1659, and 1660, before any others were publick, or by him ſo much as heard of.

By Dr. J. Beal, ib. p. 154.

2. Dr. *J. Beal* is ſo much pleaſed with the Diſcovery already made by the Help of this Inſtrument, that he thinks it to be one of the moſt wonderful that ever was in the World. For (ſaith he) who could ever expect, that we Men ſhould find an Art to weigh all the Air that hangs over our Heads, in all the Changes of it, and as it were, to weigh, and to diſtinguiſh by Weight, the Winds and the Clouds? Or, who did believe, that by palpable Evidence, we ſhould be able to prove the ſereneſt Air to be the moſt heavy, and the thickeſt Air, and when darkeſt Clouds hang neareſt to us, ready to diſſolve, or dropping, then to be lighteſt.

Ib. p. 155.

1. My Wheel Barometer I could never fill ſo exactly with Mercury, as to exclude all Air; and therefore I truſt more to a Mercurial Cane, and take all my Notes from it. This Cane is but 35 Inches long, of a very ſlender Cavity, and thick Glaſs.

2. In all my Obſervations from *May* 28, 1664, to this preſent (*December* 9, 1665,) the Quick-ſilver never aſcended but very little above 30½ Inches.

3. It aſcended very ſeldom ſo high, (*viz.* to 30¼ Inches) chiefly in *December* 13, 1664, the Weather being fickle, fair Evening.

4. I find by my Calendar of *June* 22, 1664, at 5 in the Morning, in a Time of long ſettled fair Weather, that the Mercury had aſcended about half an Inch higher than 30: But I fear ſome Miſtake, becauſe I then took no Impreſſion of Wonder at it; yet for three or four Days, at that time it continued high, in well ſettled, fair and warm Weather; moſt part above 30 Inches. So that I may note the Mercury to riſe as high in the hotteſt Summer, as in the coldeſt Winter Weather.

5. Yet ſurely I have noted it to aſcend a little higher for the Coldneſs of the Weather; and very frequently, both in Winter and Summer, to be higher in the cold Mornings and Evenings, than in the warmer Mid-day.

6. Generally in ſettled and fair Weather, both of Winter and Summer, the Mercury is higher than a little before, or after, or in rainy Weather.

7. Again, generally it deſcended lower after Rain, than it was before Rain.

8. Generally alſo it falls in great Winds; and ſomewhat it ſeemed to ſink, when I opened a wide Door to it, to let in ſtormy Winds: yet I have found it to continue very high in a long ſtormy Wind of three or four Days.

9. Again, generally it is higher in an Eaſt and North Wind (*cæteris paribus*) than in a South and Weſt Wind.

10. I tried ſeveral times, by ſtrong Fumes, and thick Smoaks, to alter the Air in my Cloſet; but I cannot affirm, that the Mercury yielded any more than might be expected from ſome Increaſe of Heat. Such as have exact Wheel Barometers, may try whether Odors or Fumes do alleviate the Air.

11. I have not in all this time found the extreameſt Changes of the Quickſilver to amount to more than $2\frac{1}{4}$, or to $2\frac{2}{8}$ Inches at moſt.

12. Very often I have found great Changes in the Air, without any perceptible Change in the Barometer; as in the dewy Nights, when the Moiſture deſcends in a great Quantity, and the Thickneſs ſometimes ſeems to hide the Stars from us. In the Days foregoing and following, the Vapours have been drawn up ſo inviſibly, that the Air and Sky ſeemed very clear all Day long. This I account a great Change between aſcending and deſcending Dews and Vapours (which import Levity and Weight) and between thick Air and clear Air; which Changes do ſometimes continue, in the alternative Courſe of Day and Night, for a Week or Fortnight together; and yet the Baroſcope holding the ſame.

13. Sometimes (I ſay not often) the Baroſcope yields not to other very great Changes of the Air: As lately (*Dec.* 18.) an extraordinary bright and clear Day; and the next following quite darkned, ſome Rain and Snow falling; but the Mercury the ſame: So on high Winds and Calms, the ſame.

14. I do conceive, that ſuch as do converſe much *ſub dio*, and walk much abroad, may find many Particulars much more exactly than I, who have no Leiſure for it, can undertake. To inſtance in one of many: *Dec.* 16, 1665, was a clear cold Day, very ſharp and ſtrong Eaſt Wind, the Mercury very near 30 Inches high; about 3 in the Afternoon I ſaw a large black Cloud drawing near us from the Eaſt and South-Eaſt, with the Eaſt Wind. The Mercury changed not that Day, nor the Day following; the Stars and moſt of the Sky were very bright and clear till nine of the Clock; and then ſuddenly all the Sky was darken'd, yet no Change of Weather happen'd. *Dec.* 17. the Froſt held, and 'twas a clear Day, till about two of the Clock in the Afternoon; and then many thick Clouds appeared low in the Weſt; yet no Change of the Weather here; the Wind, Froſt, and Quick-ſilver, the ſame. *Dec.* 18. the Mercury fell almoſt $\frac{1}{4}$ of an Inch, and the Sky and Air ſo clear and bright, and cold, with an Eaſt Wind, that I wonder'd what could cauſe the Mercury to deſcend. I expected it ſhould have aſcended, as uſually it does in ſuch clear Skies. Caſually I ſent my Servant abroad, and he diſcovered the remote Hills, about 20 Miles off, covered with Snow. This ſeemed to manifeſt that the Air, being diſcharged of the Clouds by Snow, became lighter.

15. I have ſeldom ſeen the Change to be very great at any one time; ſo that I once wonder'd to ſee, that in one Day it ſubſided about $\frac{1}{4}$ of an Inch.

16. *Jan.* 13, $166\frac{5}{6}$, the Mercury ſtood (as it did alſo the Day before) a quarter above 30 Inches; yet both Days very dark and cloudy, ſometimes very thick and miſty Air; which ſeldom falls out: For, for the moſt part, I ſee it higher in cleareſt ſettled Weather, than in ſuch cloudy and miſty Fogs. This thick Air and Darkneſs hath laſted above a Week; lately more cold, and Eaſt and North-Eaſt Wind.

17. I have not yet found any ſuch infallible Prognoſtick of theſe Changes n. 10. p. 163 of Weather, which do follow a long Serenity, or ſettled Weather. And perchance in brighter Climates it may be conſtantly infallible. I have Store of Hygroſcopes of divers Kinds; and I do remark them, and the Sweatings of Marble, and as many other famed Prognoſticks as I can hear of; but can find nothing ſo nearly indicative of the Change of Weather, as this Balance. And the open Weather-Glaſs is known to ſignify nothing at Certainty, having a double Obedience to two Maſters; ſometimes to the Weight of the Air, ſometimes to Heat, as the Service is commanded.

18. In *Jan.* $166\frac{5}{6}$, for many Days it continued very dark, ſo that all Men expected daily great Rain; and though ſometimes thick Miſts aroſe, and ſome ſmall Rain fell, yet the Quick-ſilver held at a great Height; which did indicate to me there could then be no great Change of Weather, and I was not diſappointed.

19. If the Mercury aſcends to a good Height after the Fall of Rain (as ſometimes, but leſs often it does) then I look for a ſettled Serenity; but if it proceeds after Rain in a deſcending Motion, then I expect a Continuance of broken and ſhowry Weather.

20. That we find the Weather and our Bodies more chill, cold and drooping, when the Mercury is loweſt, and the Air lighteſt; beſides other Cauſes, I gueſs that as Air is to us the Breath of Life, as Water is to Fiſhes; ſo when we are deprived of the uſual Meaſure of this our Food, 'tis the ſame to us as when the Water is drawn ebb from the Fiſhes.

21. The loweſt Deſcent of the Mercury in all the Time ſince I have obſerved it, was *Oct.* 26, 1665, in the Evening; when it was very near at $27\frac{1}{2}$ Inches: Which I find thus circumſtanced with the Weather in my Notes.

Oct. 25. Morning; Mercury at $28\frac{1}{2}$ Inches, great Storms and much Rain.

Oct. 26. Morning; Mercury at 28, Winds quiet, thick dark Clouds.

Oct. 26. Evening; Mercury at $27\frac{1}{2}$; that Day, and ſome Days following, the Weather was variable, frequent Rain, and, as you ſee, the Mercury lower than uſual.

22. Over the Place where this Mercurial Cane ſtands, I have ſet a Wind-Vane, with purpoſe of Exactneſs, of a Streamer in Braſs ſo large, and pointing to a Board indented in the Margin, that I can at a ſure Level upon the Vane, take every of the 32 Points of the Wind, half Points and quarter Points, at a good Diſtance. It were good to have an Index of Winds, that diſcovered as well their Aſcent and Deſcent, as their ſide Coaſtings.

23. By Change of Weather and Wind, the Mercury ſunk ſince *March* 12, n. 11. p. 18 more than an Inch; and this laſt Night of *March* 18, by Rain and South Wind, 'tis ſunk half an Inch.

24. I found the Quick-ſilver, *Dec.* 16, 1669, higher than I dare poſi- n. 55. p. 1115 tively affirm that it was ever ſince I had it in my Cuſtody, *viz.* ſince *May* 28, 1664. It was compleatly and apparently above half an Inch more than 30 Inches high. It continued the 14th, and ſome part of the 15th, at about that Height; ſometimes manifeſtly higher to an eighth or tenth part of an Inch. For this Baroſcope I have two Glaſs Canes in one Veſſel of

ſtagnant Quick-ſilver; and both of them agreed in this Indication. The Weather was, at firſt Diſcovery, very bright and clear, a gentle Froſt, by the Sun's Heat melting. The Air was very ſilent, no Wind ſtirring, and the curious Wind-Vane noting, that the Wind was directly in the Eaſt all the firſt Day, *viz. Dec.* 13. On *Dec.* 14. the Wind had a ſhort Swing from the North-weſt, and haſtened again towards the Eaſt; yet ſo as to be North-eaſt. During this Agitation, or Change of Winds, the Mercury deſcended a little; and after, upon the reſettling of the Wind, the Mercury aſcended a little higher than it had been the Day before.

My Houſe and Study, where I keep this Baroſcope, is on the Side of an Hill, on the higher Side of this Country, as I gueſs, near a Level with the Head of a River; which River running ſlowly, and falling into the *Severn* Sea about 20 or 30 Miles Weſtward of *Briſtol*, we cannot be very much above the Level of the Sea. My Thermoſcope ſtanding cloſe by my ſaid Barometer, was at the juſt Height of ordinary diſſolving Weather. In the following Days it was colder. Whether the late Summer Drought, or what elſe might incline this Winter Air to have more than ordinary Weight, or a ſtronger Spring, I muſt refer to the Conſideration of the more Skilful.

By Dr. J. Wallis. n. 10. p. 169. 3. In my Baroſcope I never found the Quick-ſilver higher than 30 Inches, nor lower than 28, (at leaſt ſcarce diſcernibly, not $\frac{1}{10}$ of an Inch higher than that, or lower than this:) which I mention not only to ſhew the Limits within which I have obſerved mine to keep, *viz.* full 2 Inches, but likewiſe as an Eſtimate of the Clearneſs of the Quick-ſilver from Air. For though my Quick-ſilver was with good Care cleanſed from the Air, yet I find that which Mr. *Boyle* uſeth, much better: For, comparing his with mine at the ſame Times, and both in *Oxford*, at no great Diſtance; I find his Quick-ſilver to ſtand always ſomewhat higher than mine (ſometimes near a quarter of an Inch;) which I know not how to give a more probable Account of, than that my Quick-ſilver is either heavier than his, or elſe that his is better cleanſed from the Air; (unleſs poſſibly, the Difference of the Bore, or other Circumſtances of the Tube, may cauſe the Alteration; mine being a taller Tube, and a bigger Bore than his.) And upon like Reaſon, as his ſtands higher than mine; ſo another, leſs cleanſed from Air, may at the ſame time be conſiderably lower, and conſequently under 28 Inches at the loweſt.

In thick foggy Weather, I find my Quick-ſilver to riſe; which I aſcribe to the Heavineſs of the Vapours in the Air.

In Sun-ſhiny Weather it riſeth alſo (and commonly the clearer, the more;) which, I think, may be imputed partly to the Vapours raiſed by the Sun, and making the Air heavier; and partly to the Heat, increaſing the elaſtick or ſpringy Power of the Air: Which latter I the rather add, becauſe I have ſometimes obſerved in Sun-ſhiny Weather, when there have come Clouds for ſome conſiderable time (ſuppoſe an Hour or two) the Quick-ſilver has fallen; and then upon the Sun's breaking out again, it has riſen as before.

In rainy Weather, it uſeth to fall (of which the Reaſon is obvious, becauſe the Air is lighten'd, by ſo much as falls) in ſhowry Weather likewiſe, but not ſo much as in Rain. And ſometimes I have obſerved it, upon a Hoar-Froſt, falling in the Night.

For windy Weather, I find it generally to fall; and that more univerſally, and more diſcernibly, than upon Rain: (which I attribute to the Wind's moving the Air collaterally, and thereby not ſuffering it to preſs ſo much directly downwards; the like of which we ſee in ſwimming, *&c.)* And I have never found it lower than in high Winds.

I have divers times, upon diſcerning my Quick-ſilver to fall without any viſible Cauſe at home, looked abroad; and found (by the Appearance of broken Clouds, or otherwiſe) that it had rained not far off, though not with us: Whereupon the Air being then lighten'd, our heavier Air (where it rained not) may have in part diſcharged itſelf on that lighter.

n.55.p.1116

Whereas I formerly obſerved, that in hot Weather, the Quick-ſilver in the Baroſcope did uſe to riſe obſervably, eſpecially in Sun-ſhine and the Heat of the Day; I now find (having kept the ſame Barometer for the Space of five Years unaltered) the Caſe, for theſe two Years laſt paſt, to be ſomewhat otherwiſe: and that in hot Sun-ſhiny Weather the Quick-ſilver doth rather ſubſide a little; and in extreme cold and froſty Weather it riſeth. I judge the Cauſe of theſe contrary Obſervations to be this, *viz.* That the Quick-ſilver, at its firſt putting into the Tube or Baroſcope, was not ſo perfectly cleanſed from Air, but that ſome ſmall Quantity of it did remain undiſcerned in the Quick-ſilver: Which latent Particles of Air, though ſo ſmall as not to be at all diſcernible to the Eye by Bubbles, yet by the external Heat (adding new Strength, as it uſeth to do, to its elaſtick or ſpringy Power) were ſo much expanded, as to make the Quick-ſilver ſpecifically lighter, and conſequently to riſe ſomewhat higher; and upon the Receſs of the external Heat, the Spring of the Air again ſlackning, ſuffered the Quick-ſilver to be again contracted into its former leſſer Dimenſions, and ſo to become heavier, and not to riſe ſo high as before, when it was hotter. But now the Quick-ſilver having continued in the Tube for five Years and upwards, hath, by its own Weight, cleanſed itſelf better from that little Air that was in it; and that Air, freed from its Intanglement with the Quick-ſilver, being got up into the void Part of the Tube above the Quick-ſilver, doth act contrariwiſe; that is, when it is by Heat (upon the ſtrengthning of its Spring) expanded, it preſſeth downward upon the Quick-ſilver, and doth a little depreſs it; and on the contrary, when by Froſt or very cold Weather this Air (by the Abatement of its Spring) is contracted, the Quick-ſilver, freed from that Preſſure, riſeth a little. But the riſing and ſinking upon this Account, (as well that formerly, when the Air was in the Quick-ſilver, as that now, when it is gotten above it) is not very conſiderable; hardly exceeding the 12th part of an Inch.

I ſhall add another Accident which I lately took Notice of. I obſerved in the late hard Froſt, that a little Drop of Water (which was at firſt made uſe of for the Cleanſing of the Quick-ſilver from the Air, and which hath ever ſince remained on the Top of the Quick-ſilver within the Tube) was frozen faſt to the Glaſs. Whereupon I did a little ſhake the Tube by moving it up and down, ſo as to make the Quick-ſilver undulate and ſtrike againſt it. The Noiſe upon theſe Strokes was not ſuch a dull Noiſe, as Quick-ſilver or other Liquids uſe to make in the open Air, by daſhing againſt Glaſs or Ice, or other ſuch hard Bodies; but ſuch a hard ſmart Noiſe, as hard Metals uſe to make by knocking one againſt the other; or, as if this Ice had been ſo knocked by a ſolid Piece of Iron, or other Metal of ſuch a Bigneſs. Which Difference of Noiſe from what would have been in the open Air, (where the intermediate Air muſt firſt have been beat away, before the Quick-ſilver could ſtrike the Ice, and thereby the Stroke of the liquid Body obtunded or broken) I attribute to that Voidneſs of Air, which was between the Ice and the diſtant Quick-ſilver.

Jan. 7. $16\frac{62}{70}$, the Baroſcope was at 29, but for ſome Days before about $28\frac{1}{8}$, (the Weather having been windy and rainy;) and ſo it was in the Froſt about *Dec.* 25, but then continued to riſe till about *Jan.* 2, to $29\frac{1}{8}$, but had been *Dec.* 13. at $30\frac{1}{8}$; which is the higheſt I have ever known it in my Baroſcope; $27\frac{7}{8}$ being the loweſt, that have I ever obſerved it in (*Oct.* 26, 1665) the moſt uſual Height being about 29, or ſomewhat higher.

By Mr. Boyle n.11. p.181. 4. It will be very convenient that Obſervers give Notice of the Situation of the Place where their Barometers ſtand; not only becauſe it will aſſiſt Men to judge whether the Inſtruments were duly perfected, but principally becauſe, that though the Baroſcope be good (nay, becauſe it is ſo) the Obſervations will much diſagree, even when the Atmoſphere is in the ſame State, as to Weight, if one of the Inſtruments ſtand in a conſiderably higher Part of the Country than the other.

To confirm the foregoing Admonition, I muſt now inform you, that having in theſe Parts two Lodgings, the one at *Oxford*, which you know ſtands in a Bottom by the *Thames* Side, and the other at a Place 4 Miles thence, ſeated upon a moderate Hill; I found by comparing two Baroſcopes that I made, the one at *Oxford*, the other at *Stanton St. John's*, that, though the former be very good, and hath been noted for ſuch, during ſome Years, and the latter was very carefully fill'd; yet by reaſon, that in the higher Place the incumbent Part of the Atmoſphere muſt be lighter than in the lower, there is almoſt always between two and three Eighths of an Inch Difference betwixt them: And having ſometimes order'd my Servants to take Notice of the Diſparity, and divers times carefully obſerved it myſelf, when I paſſed to and fro between *Oxford* and *Stanton*, I generally found that the *Oxford* Barometer and the other did, as it were by common Conſent, riſe and fall together ſo, as that in the former the Mercury was uſually $\frac{1}{8}$ higher than in the latter. Which Obſervations may teach us, that the ſubterraneous Steams which aſcend into the Air, or the other Cauſes of the varying Weight of the Atmoſphere, do many times, and at leaſt, in ſome Places, uniformly enough affect the Air to a greater Height, than, till I had made this Trial, I durſt conclude.

But as moſt of the barometrical Obſervations are ſubject to Exception, ſo I found the formerly mentioned to be. For (to omit leſſer Variations) riding one Evening from *Oxford* to *Stanton*, and having before I took Horſe look'd on the Baroſcope in the former of theſe two Places, I was ſomewhat ſurpriz'd to find at my coming to the latter, that in Places no farther diſtant, and notwithſtanding the Shortneſs of the Time (which was but an Hour and a half, if ſo much) the Barometer at *Stanton* was ſhort of its uſual Diſtance from the other near a Quarter of an Inch; though, the Weather being fair and calm, there appear'd nothing of manifeſt Change in the Air, to which I could aſcribe ſo great a Variation; and though alſo ſince that Time the Mercury in the two Inſtruments hath, for the moſt part, proceeded to riſe and fall as before.

The Quickſilver has been of late for the moſt part ſo high, as to invite me to take Notice of it; and about *March* 12, $166\frac{5}{6}$. at *Oxford*, the Quick-ſilver was higher than, for ought I know, has been yet obſerved in *England*, *viz.* about $\frac{1}{12}$ above 30 Inches; but upon the firſt conſiderable Showers that have interrupted our long Drought, as I foretold divers Hours before that the Quickſilver would be very low, (a bluſtering Wind concurring with the Rain) ſo I found it at *Stanton* to fall $\frac{4}{8}$ beneath 29 Inches.

It is difficult enough to ſettle any general Rule about the riſing and falling of the Quick-ſilver; yet in theſe Parts one of thoſe that ſeem to hold ofteneſt, is, that when high Winds blow, the Mercury is the lower; and yet that it ſelf does ſometimes fail.

5. At my firſt Arrival I fix'd my Weather Glaſs, and found the *Argentum Vivum* to aſcend 29 Inches, and in a Tornado $29\frac{1}{10}$. But a Stranger by Accident broke the Cane, ſo that I could make no further Trial.

At Cabo-Cors *in* Guinea; *by Mr.* Heathcot, n. 158. p. 578.

6. When my Barometer was firſt ſet up, the Mercury ſtood one Degree below Changeable; I diligently obſerved it every Day, and found that in the Mornings before the Sun aroſe, it would be there; and as the Heat encreaſed with the Day, it ſunk to within one Degree above Rain; there it continued ſeveral Days, and never altered above 3 Degrees, though ſometimes Fair, ſometimes Rain, and ſometimes Cloudy; and one Morning leaving open my Window, and the Sun having South Declination, it ſhone in on the viſible Part of the Tube, and in half an Hour it ſunk 3 Degrees; (which I never obſerved it to do with Heat in *England*) I preſently ſhut the Window, and in one Hour it aroſe again to within 1 Degree of Changeable. After it had kept this Courſe in ſeveral Weathers, for 6 Weeks together, I began to doubt if it were well adjuſted, and therefore took it down, new fill'd the Tube, turned it 3 or 4 Times up and down, to let out the Air, and put it up with great Care; and ever ſince it continues the ſame, never by one Degree to Changeable, nor down by one Degree to Rain, ſo that the whole Progreſs of the Mercury is but $\frac{3}{10}$ of an Inch.

In Jamaica, *by Sir* Will. Beeſton, n. 220. p. 225.

7. *March* 3, $168\frac{6}{7}$, in the Evening, we had very much Thunder; and that and the next Day, the Mercury in the Barometer was much lower than ever I obſerved it, *viz.* but $\frac{4}{10}$ above 28 Inches.

The loweſt Degree of the Barometer; by the Bp. of Cloyne, n. 243, p. 293.

8. I have found by a whole Month's Obſervations, Mr. *Flamſteed* was pleaſed to ſend me, the Mercury ſtill roſe and fell both at *London* and here exactly at the ſame Time; I always found it rather more than $\frac{3}{10}$ of an

The Agreement of the Barometers at London *and* Townley; *by Mr.* Townley, n. 208. p. 56.

Inch lower here than there, by reaſon that we are ſeated, though in a ſeeming Valley, in reſpect of the Neighbouring Grounds, yet we are conſiderably higher than the other low Lands near the Sea, where the Standard differs little from that at *London*. In Confirmation of what I have ſaid, I ſuppoſe you may not be diſpleaſed with two remarkable Obſervations made both by Mr. *Flamſteed* and me at the ſame Time, *viz. Nov.* 18, 1674. when finding the Mercury to deſcend both very faſt, and very low, we watched it very nicely, and both of us obſerved, that at 2 in the Afternoon it was rather falling, and rather riſing at 4; at which Times the Height was only here 27, 63 Inches, and at *London* $\frac{1}{10}$ higher.

A Portable Barometer; by Mr. Will. Derham, n. 236, p. 3.

V. Provide a ſtrong Glaſs Tube, let the Head of it be pinched at about an Inch from the Top, ſo as to make a narrow Neck, whoſe Orifice ſhall be as big almoſt as a Straw. This (which is Mr. *Quare*'s Way) will much bridle the Blow of the Mercury againſt the Top, as it danceth up and down, which endangers breaking off the Top of the Tube. The Bottom of the Tube I would have ground aſlant near half an Inch, that the Bottom of the Tube touching the Bottom of the Ciſtern, the Orifice thereof may lie about the middle of the Mercury in the Ciſtern; which will prevent the Air getting into the Tube, by reaſon the Mercury is always about the Mouth of the Tube. The Ciſtern muſt be made wide, either of Glaſs, or cloſe grained Wood; round the Brim of which, on the out-ſide, muſt be a Notch to tie on the Leather that is to cover it. When the Tube is filled, cleared of Air, and plunged into the Ciſtern near full of Mercury, encloſe the Mercury with gentle Leather tied very faſt round the Tube near the Bottom, which being ſpread over the Ciſtern, tie it round that alſo: The Tube and Ciſtern, thus conjoined with Leather, muſt be lodged in a Caſe, made very fit to receive both, where they muſt lie very faſt. Through the Caſe let 3 or 4 Holes be bored, to let the Air in freely to the Leather that covers the Ciſtern, which lying cloſe againſt the Holes, will firmly enough keep the Mercury from running out at them.

To enlarge the Diviſions of the Barometer; by Dr. Hook, n. 185. p. 241.

VI. 1. To make the more minute Variations in the Air's Preſſure ſenſible, Dr. *Hook* invented the Wheel Barometer. But this did not anſwer fully the deſigned Exactneſs, both for that the Mercury being apt to ſtick againſt the Sides of the Glaſs, would riſe and fall *per ſaltum* all at once; and becauſe it is very difficult to adjuſt the *apparatus* of this Inſtrument, as alſo, that it is exceeding apt to be out of order; for which Reaſons it is at preſent almoſt wholly laid aſide.

Upon this, in *June* 1668. (as appears on the Journal of the *Royal Society*) he bethought himſelf of another Device to do the ſame Thing; which was to encreaſe the Diviſions, by putting coloured Spirit of Wine, or ſome other Liquors not capable of freezing, on the Mercury, which Liquor was made to riſe as the Mercury fell, and fall as it roſe, in a narrow Cane, ſo as to make the utmoſt Limits about two foot aſunder. But yet he was not ſatisfied, till he had found out the Means of encreaſing the Diviſions of the Barometer *ad libitum*, which he produced before the *Royal Society* at their Meeting on *Feb.* 3, 1685. *ſt. vet.* The Contrivance whereof is this:

The Cylinder, *A*, may be of what Diameter you pleaſe, the bigger the better, but it need not be above 2 Inches long; the Cane, *A D*, muſt be ſo long that the upper Part of the Cylinder, *B*, may be 29 Inches × ſuch a Part of the Height of the other Cane, *B C*, as the Weight or ſpecifick Gravity of the Liquor that is to fill that Cane, is to the ſpecifick Gravity of Mercury, below the Line, *A B*, in the Cylinder, *A*. The third Cylinder, *C*, may be as high as you pleaſe above the Cylinder, *B*, but is moſt conveniently made, ſo as the Square of the Diameter of the Cane, *B C*, be to the Square of the Diameter of the Cylinders, *B* or *C*, (which muſt be exactly equal) as the Riſe of the Mercury in the Cylinder, *B*, is to the whole Length of the Cane, *B C*; for in this Caſe there will be nothing ſuperfluous, but the Diviſions enlarged to the utmoſt Advantage. Fig. 1.

As to the Method of filling this Baroſcope, though the Inventor hath not as yet declared his own Contrivance for the doing it, yet it will not be unneceſſary to ſhew here how it may be done. One Way (and the beſt that occurs at preſent) is to leave a ſmall Hole at the Top of the Cylinder, *A*, and another near the Top of the Cylinder, *B*; this latter being well ſtopt, pour in as much Mercury at the other Hole, in *A*, as ſhall fill both Canes as high as the Level of the ſaid Hole; which done, ſtop either by hermetically ſealing it, or elſe by a Drop of Seal-wax (the Glaſs being firſt ground rough to make it ſtick) in the Hole, *A*; then opening the Hole in *B*, draw off as much of the Mercury of the Cane, *B C*, till it will run no longer; which done, ſtop firmly the Hole in *B* (which may be done as you pleaſe, there being no Preſſure againſt you) and you will have the Cylinder, *A*, evacuated of Air, for your Purpoſe, and the Height of the Mercury will be as is uſual in the ordinary Plain and Wheel Barometers. Then pour into the Cane, *B C*, as much Spirit of Wine tinged with Cochineal, and Oil of Turpentine, equal Parts of each, as ſhall ſtand above the Surface of the Mercury ſo many Feet as you make the enlarged Scale of your Barometer, or as is between the Middle of the Cylinders *B* and *C*; and you will find the Mercury ſink in the Cane, *B C*, and riſe in the other Cane, *AD*, in ſuch Proportion, that each 13 Foot of Oil and Spirit will raiſe the Mercury 10 Inches: This done, you muſt pour on, by the Cane, *B C*, ſo much Mercury as may fill up the Cylinders, *A* and *B*, to ſuch Heights, conſidering the preſent Weight of the Atmoſphere, that the Surface of the Mercury in both, may at the utmoſt Limits (which have not in *England* been found to exceed 30, 6 and 28, 6 Inches) always fall within the Bodies of the Cylinders, and never enter into the Canes.

Here note, That theſe Liquors are choſen upon two Accounts; Firſt, they are exceeding near of a Weight, and Spirit of Wine highly rectified is ſomewhat lighter than Oil of Turpentine, but by a very ſmall Addition of Phlegm or Water, the Spirit will preponderate and be undermoſt; ſo that you may make them as near of a Weight as you pleaſe, and conſequently a Cylinder of the Oil inſenſibly differing from an equal Cylinder of Spirit of Wine. Secondly, They are Liquors that will not mix; ſo that the Oil of Turpentine ſwimming on the Top, will be divided by a Line only from the tinged Spirit of Wine, which the Oil will keep from evaporating.

The Effect of this Baroſcope will be, that when the Atmoſphere is heavy, and the Mercury raiſed high in the Cylinder *A*, and retired out of *B*, the Spirit of Wine will deſcend into the Cylinder *B*, and the Oil of Turpentine will fill the Cane, ſo as to make the Partition of the two Liquors near the Cylinder *B*. But on the contrary, when the Air is light, the Mercury will ſink in *A*, and riſe in *B*, ſo as to drive the Spirit of Wine into the Cane, and the Oil of Turpentine into the Cylinder *C*, ſo that the Section of the two Liquors will be near *C*, and the Variation of the Height of the Mercury will be enlarged into almoſt the Length of the Cane, without that the Counter-preſſure from the Liquors will be in the leaſt altered, the Height and Weight of the incumbent Cylinders being always the ſame.

That little Alteration that may happen by the Dilatation and Contraction of the Spirit of Wine by Heat and Cold, which ought to be accounted for, may be beſt diſcovered by a Thermometer hanging by it, (containing the ſame Quantity of the Spirit of Wine, and whoſe Cane is, as near as may be, of the ſame Diameter with the Cane *B C*, in the Barometer) whoſe Deſcent and Aſcent muſt be added and ſubſtracted to reduce it to a rigorous Exactneſs; but it is ſtill worth while to enquire if the Mercury itſelf do not ſhrink and ſwell with Cold and Heat, ſo as not to need this Correction.

By —— n. 236. p. 4. *Fig.* 2.

2. *A.* The Head of the Tube, with its narrow Neck, to bridle the Blow of the Mercury, as formerly directed for a portable Barometer.

B. The Bottom ground aſlant.

C. The Crook.

D. D. The Weather Plates.

By bending the Tube more or leſs at *C*, an Inch of perpendicular Height may be made 2 or 3 Inches.

By Mr. Derham, n. 237. p. 45. *Fig.* 3.

3. *AA.* A Ruler with Teeth on one Edge of it, made to ſlide up and down.

b. A little Finger, fix'd to the Ruler, which muſt be raiſed or depreſſed till it point exactly to the Height of the Mercury.

CCCC. The Index Wheel containing juſt as many Teeth as there are Teeth in an Inch of the ſliding Ruler; ſo that thruſting up and down this toothed Ruler, you may at every Inch turn round the Index once.

DDDD. A Circle, divided into 100 Parts, anſwering to 100 parts of an Inch on the ſliding Ruler.

ee. The Index, which being faſtned to the Arber of the Index Wheel, is driven round with it, and ſhews on the Circle, the parts of an Inch which the Mercury riſeth or falleth in the Tube.

Fig. 3. *By Mr* Steph. Gray, n. 240. p. 176. *Fig.* 4.

4. *A.* A long ſquare Table: Towards one End is erected a ſquare Column, *BB.* upon which there ſlides a ſquare Socket, *C*, from one ſide whereof proceeds a crooked Arm, *D E*. At *D* there is a Screw-hole to receive the Screw, and at *E* a Ring to ſupport the Tube of the Microſcope, *F*. From the other ſide the Socket comes a ſhort Arm *G*, having a Screw-hole to receive the long Screw, *II*, whoſe Length may be about 6 or 7 Inches; its lower End, by a ſmall Hole in its Center, reſts on the End of a ſmall Screw, that comes through the Screw-hole, in the Arm *H*, which is fixed on the back-ſide of the Column; the upper End of the Screw is filed leſs than the Body of the Screw, and goes

through the Center of the round Plate without ſhaking; and to prevent its doing ſo, either upwards or downwards, there is added a ſpringing Plate, *n*, which keeps the Shoulder of the Screw cloſe to the Underſide of the Plate, *K*; over this Plate there goes an Index, *o*, and over that an Handle, *L*, upon the End of the Screw, which comes through the Center of the Plate, which I ſhould before have told you, is riveted to the Top of the Column, *BB*. The Teeth of the Screw muſt be of that Size, as to have juſt 10 in an Inch. The Foreſide of the Column muſt be divided into Inches and Tenths, beginning about the Height of the Socket, *H*, where the lower End of the Screw reſts, and ſo continuing to the Top of the Column. The Limb of the round Plate muſt be divided into an 100 Parts. In the Focus of the Eye-glaſs of the Microſcope is fixed an Hair, or very fine ſilver Wire, in an Horizontal Poſition.

When you uſe this Inſtrument, take hold of the Handle, and looking through the Microſcope, turn the Screw till you have brought the Hair to touch, as it were, the Surface of the Mercury, *m*; then obſerve what Diviſions are cut on the Column, by the upper or under Edge of the Socket, which are Tenths of an Inch. See likewiſe to what Parts the Index points on the Limb of the round Plate; which are Hundreds of a Tenth, or Thouſand Parts of an Inch: When you perceive the Mercury varied, raiſe or depreſs the Microſcope, till the Hair be brought to its Surface, as before; then by ſubſtracting the leſſer from the greater of the two obſerved Numbers, you will have the Variation in Inches and thouſand Parts.

This Inſtrument becomes a Micrometer on the ſame Principles, though I was obliged to alter its Structure from that uſed with the Teleſcope, which was firſt invented by Mr. *Gaſcoign*, improved by Mr. *Townley*, and deſcribed by Dr. *Hook*.

Vid. Vol. I. Chap. IV. S. V. 1, 2.

The Thermometer is alſo capable of the like Improvement.

The Height of the Mercury at the Top of Snowdon Hill; *by Mr.* Halley, n. 229. p. 582.

VII. 1. *May* 26, 1697, between one and two in the Afternoon, on the Top of *Snowdon Hill*, I thrice repeated the *Torricellian* Experiment, and as often found the Height of the Mercury 26, 1 Inches. And being come down to *Llanberris*, at the Foot of the Hill, about 6 that Evening, I as often found it 29, 4 Inches. The next Day, about 8 in the Evening, I found the Mercury, by a triple Experiment, to ſtand at 29, 9 Inches, very near the Surface of the Sea; when at the ſame Time, at *Llanerch* in *Denbyſhire* (about 25 Miles Eaſt from *Snowdon*, and 6 from the Sea, ſeveral Foot above the Surface of it) by Mr. *Davis*'s ſtanding Barometer, it was above 29, 7 ½: And the Air continued both before and after in the ſame State. Hence I conclude, That the Difference of the Air's Preſſure on the Sea, and on the Top of *Snowdon*, is rather more than 3 Inches, 8 Tenths. I could have wiſhed for one of Mr. *Hunt*'s portable Barometers, which will certainly be accurate enough for taking the Levels for bringing of Water from diſtant Places, and certainly much leſs ſubject to Error; there being a Tenth of an Inch for each 30 Yards; which may be divided into many Parts evidently. *Snowdon* was meaſured by Mr.. *Caſwell*, with *Adam*'s Inſtruments, to be 1240 Yards high; which abating the Height of the Mercury, 3 Inches 8 Tenths, may ſerve for a Standard, till a better be obtained on a higher Place.

2. This

Conſidered; by Dr. Wallis, n. 233. p. 653.

2. This Obſervation had been more uſeful, had it been repeated at ſeveral other perpendicular Heights in the Aſcent. For from ſuch comparative Obſervations, we may make a Judgment of the Height of the Atmoſphere.

At the Top of the Monument; *by Mr.* Derham, n. 236. p. 2.

VIII. In *Sept.* 1696. I obſerved the Variation of the Mercury on the *Monument*; and found, by one of Mr. *Quare*'s beſt portable Barometers, that it deſcended $\frac{1}{10}$ of an Inch at the Height of 80 Feet, and $\frac{2}{10}$ at 160 Feet.

But ſince that, finding my Obſervations a little different from Mr. *Halley*'s on *Snowdon Hill*, I try'd it again, more nicely, in *Nov.* 1697. after this Manner. I provided a pretty large glaſs Tube, well cleaned: This I lodged in Wire, and fill'd it with well ſtrain'd Mercury; which being clear'd of all Air, I then plung'd the Bottom of the Tube into a broad Ciſtern of Mercury; and then fixed both the Tube and Ciſtern together, in a Wire Caſe or Frame. On the Top I left an Eye in the Wire, to ſuſpend the whole Barometer on a String, that it might hang penduloully, which is abſolutely neceſſary; becauſe if the Ciſtern be deeper on one Side than another, or if the Tube hang more towards one Side than the other, it will cauſe a great and erroneous Variation in the Mercury above, according as the Tube ſtands perpendicularly, or not.

My Inſtrument being thus (I think) very nicely prepared, I marked exactly the Height of the Quick-ſilver, upon 2 narrow Labels of Paper, paſted on each Side the Tube, both at the Bottom, and in my Aſcent up the *Monument.* The Differences of the Mercury's Height I meaſured with a decimal Inch Scale of thin Braſs. The Quantity of my Aſcent I meaſured with a *Gunter*'s Chain, becauſe a String would ſtretch. By the niceſt Obſervation I could make, I found that at the Height of 82 Feet, the Mercury fell $\frac{1}{10}$ of an Inch, and about 164 Feet $\frac{2}{10}$.

By tarrying above ſomewhat long, I perceived the Preſſure of the Atmoſphere was ſomewhat altered; ſo that the Mercury, in my Deſcent, was about 0,01 of an Inch different from my Obſervations in aſcending. Upon which I repeated my Experiment, by aſcending and deſcending quicker. At both which Times, my Obſervations agreed exactly with the firſt Trial. From whence I conclude, that at every 82 Feet Height, or thereabouts, the Mercury will deſcend $\frac{1}{10}$ of an Inch. But I am inclined to think, that the Mercury riſeth or falleth, ſometimes more, ſometimes leſs, at one and the ſame Height. As for Inſtance, If the Mercury ſinketh 0,1 of an Inch, at the Height of 82 Feet, when the Mercury ſtandeth at 30 Inches in the Barometer, I *query*, whether it will ſink ſo much when the Barometer is at 29 Inches. n. 237. p. 46.

The Heights of the mercurial Cylinder at any Elevation above the Surface of the Earth; by Mr. Halley, n. 181. p. 104.

IX. It has been ſhewn, by undoubted Experiments, that the ſpecifick Gravity of the Air, near the Earth's Surface, to that of Water, was once as 1 to 840, again, as 1 to 852, and a 3d Time, in a very large Veſſel, holding ten Gallons, as 1 to 860; all which, conſidering the Difficulty of the Experiment, agree well enough, the Mercury ſtanding at all thoſe Times about 29 Inches $\frac{2}{4}$; but by Reaſon 'twas Summer Weather, and conſequently the Air rarified, when all theſe were try'd, we may, without ſenſible Error, ſay in round Numbers, that the Barometer ſtanding at 30 Inches, and in a mean State of Heat and Cold, the ſpecifick Gravity of the Air to Water, is as 1 to 800. By the like Trials the Weight of the Mercury to

Water, is as 13½ to 1, or very near it; ſo that the Weight of Mercury to Air, is as 10800 to 1, and a Cylinder of Air of 10800 Inches, or 900 Feet, is equal to an Inch of Mercury; and were the Air of an equal Denſity, like Water, the whole Atmoſphere would be no more than 5,1 Miles high; and in the Aſcent of every 900 Feet, the Barometer would ſink an Inch. But the Expanſion of the Air increaſing in the ſame Proportion as the incumbent Weight of the Atmoſphere decreaſes, that is, as the Mercury in the Barometer ſinks, the upper Parts of the Air are much more rarified than the lower; and each Space anſwering to an Inch of Quick-ſilver, grows greater and greater; ſo that the Atmoſphere muſt be extended to a much greater Height.

Theſe Expanſions of the Air being reciprocally as the Heights of the Mercury, it is evident, that by the Help of the Curve of the *Hyperbola* and its *Aſymptotes*, the ſaid Expanſions may be expounded to any given Height of Mercury; for by the 65th *Prop. Lib.* 2. *Conic. Mydorgii*, the Rectangles *Fig.* 5. *A B C E*, *A K G E*, *A L D E*, *&c.* are always equal; and conſequently the Sides, *C B*, *K G*, *L D*, *&c.* are reciprocally as the Sides, *A B*, *A K*, *A L*, *&c.* If then the Lines, *A B*, *A K*, *A L*, be ſuppoſed equal to the Heights of the Mercury, or the Preſſures of the Atmoſphere, the Lines *C B*, *K G*, *L D*, anſwering thereto, will be as the Expanſion of the Air under thoſe Preſſures, or the Bulks that the ſame Quantity of Air will occupy; which Expanſions being taken infinitely many, and infinitely little (according to the *Method* of *Indiviſibles*) their Sum will give the Spaces of Air between the ſeveral Heights of the Barometer; that is to ſay, the Sum of all the Lines between *C B*, and *K G*, or the Area, *C B K G*, will be proportioned to the Diſtance or Space intercepted between the Levels of two Places in the Air, where the Mercury would ſtand at the Heights repreſented by the Lines, *A B*, *A K*; ſo then the Spaces of the Air, anſwering to equal Parts of Mercury in the Barometer, are as the Areas, *C B K G*, *G K L D*, *D L M F*, *&c.* Theſe Areas again are, by the Demonſtration of *Gregory* of *St. Vincent*, proportionate to the Logarythms of the Numbers, expreſſing the *Rationes* of *A K* to *A B*, of *A L* to *A K*, of *A M* to *A L*, *&c.* So then, by the common Table of Logarythms, the Height of any Place in the Atmoſphere, having any aſſigned Height of the Mercury, may moſt eaſily be found: For the Line *C B*, in the *Hyperbola*, whereof the Areas deſign the Tabular Logarythms, being 0,0144765; 'twill be as 0,0144765, to the Difference of the Logarythms of 30, and any other leſſer Number; ſo 900 Feet, or the Space anſwering to an Inch of Mercury, if the Air were equally preſt with 30 Inches of Mercury; and every where alike, to the Height of the Barometer in the Air; where it will ſtand at that leſſer Number of Inches: And by the Converſe of this Proportion may the Height of the Mercury be found, having the Altitude of the Place given. From theſe Rules I derived the following Tables.

Given Heights of the Mercury.	*Altitudes.*	
Inches	Miles	Feet
30		0
29		915
28		1862
27		2844
26		3863
25		4922
20		10947
15		18715
10		29662
5		48378
1		91831
0,5		110547
0,25		129262
0,1	29 *or*	154000
0,01	41 *or*	216169
0,001	53 *or*	278338

Given Altitudes.	*Heights of the Mercury.*
Feet	Inches
0	30, 00.
1000	28, 91.
2000	27, 86.
3000	26, 85.
4000	25, 87.
5000	24, 93.
Miles 1	24, 67.
2	20, 29.
3	16, 68.
4	13, 72.
5	11, 28.
10	4, 24.
15	1, 60.
20	0, 95.
25	0, 23.
30	0, 08.
40	0, 012.

Upon theſe Suppoſitions it appears, that at the Height of 41 Miles, the Air is ſo rarified as to take up 3000 Times the Space it occupies here; and at 53 Miles high it would be expanded above 30000 Times; but 'tis probable, that the utmoſt Power of its Spring cannot exert itſelf to ſo great an Extenſion, and that no Part of the Atmoſphere reaches above 45 Miles from the Surface of the Earth.

This ſeems confirmed from the Obſervations of the *Crepuſculum*, which is obſerved commonly to begin and end when the Sun is about 18 *Deg.* below the *Horizon*; for ſuppoſing the Air to reflect Light from its moſt rarified Parts; and that as long as the Sun illuminates any of its Atoms, they are viſible to an Eye not intercepted by the Curvity of the Earth, it will follow, that the Proportion of the Height of the whole Air, to the Semidiameter of the Earth, is much about as 1 to 90, or as the Exceſs of the Fig. 6. Secant of about 8 ½ *Deg.* to Radius. For if *E* be the Eye of the Obſerver, *S*, a Place where the Sun ſets at the End of Twilight in *E*, and the Arch *E G S*, or *T C A*, be found 18 *Deg.* the Exceſs of the Secant of Half thereof, *E C H*, would be the Height of the Air, *viz.* *G H:* But the Beam of the Sun, *A S H*, and the viſual Ray, *E H*, do each of them ſuffer a Refraction of about 32 or 33 *Min.* whereby, being bent inwards from *H*, towards *G*, the Height of the Air need not be ſo great as if they went ſtreight; and having from the Angle *ECS*, taken the double Refraction of the *Horizontal* Ray, the half of the Remainder will be 8½ Deg. *circiter*; whoſe Secant being 10111, it follows that as 10000 to 111, ſo the Semidiameter of the Earth, ſuppoſed 4000 Miles, to 44,4 Miles; which will be the Height of the whole Air, if the Places, *E*, *S*, whoſe viſible Portions of the Atmoſphere *ERZH*, and *SHKB*, juſt touch one the other, be 18 Deg. aſunder.

At this Height the Air is expanded into above 3000 Times the Space it occupies here, and we have ſeen the Experience of condenſing it into the 60 Part of the ſame Space; ſo that it ſhould ſeem, that the Air is a Subſtance capable of being compreſſed into the 180000 Part of the Space it would naturally take up, when free from Preſſure: Now what Texture or Compoſition of Parts ſhall be capable of this great Expanſion and Contraction, ſeems a very hard Queſtion; and which, I ſuppoſe, is ſcarce ſufficiently accounted for, by the comparing it to Wool, Cotton, and the like ſpringy Bodies.

'Tis true, the Weight of the whole Atmoſphere is various, being counterpoiſed ſometimes by 28½ Inches of Mercury, and at other Times by no leſs than 30½, ſo that the under Parts being preſſed by about a 15th Part leſs Weight, the ſpecifick Gravity of the Air upon that Score, will ſometimes be a 15th Part lighter than another; beſides, Heat and Cold does very conſiderably dilate and contract the Air, and conſequently alter its Gravity; to which add the Mixture of Effluvia or Steams riſing from almoſt all Bodies, which aſſimulating into the Form of Air, are kept ſuſpended therein, as Salts diſſolved in Liquors, or Metals in corroding Menſtrua; which Bodies being all of them very much heavier than Air, their Particles by their Admixture muſt needs encreaſe the Weight of that Air they lie incorporated withal, after the ſame manner as melted Salts do augment the ſpecifick Gravity of Water. 'Tis alſo true, that the Condenſations are not poſſible beyond certain Degrees; for being compreſſed in an 800th Part of the Space it takes up here, its Conſiſtence will be equally denſe with that of Water, which yields not to any Force whatſoever, as hath been found by ſeveral Experiments tried here, and at *Florence* by the *Academia del Cimento*; nor can the Rarefaction proceed *in infinitum*; for ſuppoſing the Spring whereby it dilates itſelf, occaſioned by what Texture of Parts you pleaſe, yet muſt there be a determinate Magnitude of the natural State of each Particle, as we ſee it is in Wool, and the like, whoſe Bodies being compreſſible into a very ſmall Space, have yet a determinate Bulk which they cannot exceed, when freed from all manner of Preſſure.

Theſe Objections diſturb the Geometrical Accuracy of theſe Concluſions drawn from the ſpecifick Gravity of the Air, obſerved at any Time; but the Method here ſhewn will compute, by a like Calculation, the Heights of the Quick-ſilver, and the Rarefactions of the Air from any aſſigned Height of the Barometer at the Earth's Surface, and any ſpecifick Gravity given. As to the Condenſation and Rarefaction by Heat and Cold, and the various Mixtures of aqueous and other Vapours, theſe two Objections ſeem generally to compenſate each other; for when the Air is rarified by Heat, the Vapours are raiſed moſt copiouſly, ſo that tho' the Air, properly ſo call'd, be expanded, and conſequently lighter, yet the Interſtices thereof being crouded ed full of Vapours of much heavier Matters, Bulk for Bulk, the Weight of the Compoſitum may continue much the ſame; at leaſt a moſt curious Experiment made by the ingenious Mr. *John Caſwel* of *Oxford*, upon the Top of *Snowdon Hill* in *Caernarvonſhire*, ſeems to prove that the firſt Inches of Mercury have their Proportions of Air near enough to what I now determine; for the Height of the Hill being 1240 Yards, or very near it, he found the Mercury to have ſubſided to 25,6 Inches, or 4 Inches below the mean Altitude thereof at the Level of the Sea, and the Space anſwering to 4 Inches, by my Calculation ſhould be 1288 Yards: And it agrees as well with the Obſervation in the Appendix to Mr. *Paſcall*'s Book, *de l'Equilibre des Liquers*, made on the high Hill in *Auvergne*, call'd *Le Puy de Domme*. So that the Rarefaction and Vapours ſeem not to have alter'd conſiderably the Gravity of the under Parts of the Air; and much above the Height where theſe Experiments were made, do few Vapours aſcend, and the Cold is ſuch, that the Snow lies continually; ſo that for the more elevated Parts of the Sphere of Air there is much leſs Reaſon to doubt.

The Reaſon of the Aſcent of the Quick-ſilver; by Dr. Liſter, n. 165. p. 970.

X. 1. It is obſerved of the Barometer, that the Quick-ſilver is not affected with the Weather, or very rarely, let that be either cloudy, rainy, windy, or ſerene, in St. *Helena*, or the *Barbadoes:* and therefore probably not within the *Tropicks*, unleſs in a violent Storm or Hurricane. The firſt is affirmed by Mr. *Halley*, who kept a Glaſs near two Months in the Iſland of St. *Helena*, and the other of *Barbadoes* ſtands upon the Credit of our Regiſters.

2. In *England*, in a violent Storm, or when the Quick-ſilver is at the very loweſt, it then viſibly breaks and emits ſmall Particles, as I have more than once obſerved; which Diſorder I look upon as a kind of Fretting; and conſequently at all Times of its Deſcent, it is more or leſs upon the Fret.

In this Diſorder of the Quick-ſilver, I imagine it hath its Parts contracted, and cloſer put together; which ſeems probable, for that, for Example, the Quick-ſilver then emits, and ſqueezes out freſh Particles of Air into the Tube, which encreaſing the Bulk of the Air, and conſequently its Elaſticity, the Quick-ſilver is neceſſarily depreſs'd thereby, that is, by an external Force or Power; and alſo the Quick-ſilver muſt of itſelf come cloſer together, in its own internal Parts, that is, deſcends, for both Reaſons.

And that much Air is mixed with it, appears from the Application of a heated Iron to the Tube, as is practiſed in the purging of it that way; and alſo for that poliſh'd Iron will ruſt, though immers'd in it, as ſome Philoſophers have lately obſerved.

Now when the Quick-ſilver riſes in the Pipe (which it certainly does both in hot and froſty Weather) it may then be ſaid to be in a natural State, free, open, and expanded like itſelf, which it ſeems it ever is within the *Tropicks*, and with us only in very hot and very froſty Weather. But when it deſcends, it is then contracted, and as it were convulſed and drawn together, as it moſtly is in our Climate of *England*, and more or leſs, as we gueſs, in all Places on this Side the *Tropicks*. Which Contraction plainly appears from the concave Figure of both Superficies, not only in that of the Quick-ſilver in the Tube, but alſo (if well obſerved) in that which ſtagnates in the Pot or Diſh itſelf.

The Difficulty ſeems to lie in the reconciling the ſame Effect of the Quick-ſilver's riſing in the Tube, from ſuch ſeemingly different Cauſes, as great Heat and intenſe Froſt: and thoſe who ſhall willingly aſſent to us in one Particular, and grant us Warmth as a probable Cauſe of its Reſtitution to its Nature, will yet be at a Stand how to imagine, that great Froſt likewiſe ſhould bring the Quick-ſilver nearer its own Nature too. I anſwer, that Salts liquified will coagulate or cryſtallize, that is, will return to their own proper Natures, both in Cold and in Heat; and therefore, tho' moſt Men practiſe the ſetting them in a cool Cellar for that Purpoſe, yet ſome (as *Zwelfer*) adviſe, as the beſt Means to have them ſpeedily and fairly cryſtallized, to keep them conſtantly *in Balneo*. Thus alſo the Lympha of the Blood does become a Jelly, if you ſet it in a cool Place, and the ſame is by Warmth in like manner inſpiſſated. Again, that it is no new Opinion, that Water is naturally Ice, if no Diſquiet from ſome external Accident hinder. *Bornichius*, the learned *Dane*, has ſaid ſomething for it: And altho' ſome may think that what he hath ſaid, was a mere Compliment to his own frozen Climate, yet I dare venture to add, in Confirmation of that Doctrine, that Salt is naturally Rock, that is, naturally foſſile, not liquid; and yet this is moſt like Ice of any thing in Nature, not only becauſe of its Tranſparency, but alſo for its eaſy Liquefaction, and the ſudden Impreſſions and Changes which Air makes upon it, ſo that it is ſcarce to be preſerved in its natural State of Cryſtallization. Alſo Salts of all ſorts ſeem naturally to propagate themſelves in a hard State, and to vegetate in a dry Form. The like is to be obſerved in Quick-ſilver, of its being a hard Rock, and alſo from its Willingneſs to embrace upon all Occaſions a more fix'd State, as in its Amalgamizing with almoſt all ſorts of Metals.

It will not be amiſs by way of Corollary, to add a Note or two about healthful and ſickly Seaſons, more particularly as they may refer to this *Phænomenon* of great Cold and Froſt. If therefore Quick-ſilver and Liquids are neareſt their own Natures, and have leſs Violence done to them, in very cold and very hot Seaſons, the Humours of our Bodies, as Liquids, in all Probability, muſt be in ſome meaſure accordingly affected. And that therefore Cold is healthful, I argue from the vaſt Number of old Men and Women, to be found upon the Mountains of *England*, comparatively to what are found elſewhere.

Again, the Blood itſelf, or the vital Liquor of Animals equivalent to it, is in moſt Kinds of Animals in Nature ſenſibly cold; for that the Species of Quadrupeds and Fowls are not to be compared for Number to Fiſhes and Inſects; there being, in all Probability, by what I have obſerved, above a hundred Species of theſe latter Creatures, whoſe vital Juice is cold, to one of the former: But becauſe we moſt converſe with thoſe whoſe vital Juice is hot, we are apt to think the ſame of all.

Again, I have obſerved, which I offer as an Argument of the little Injury intenſe Cold does to the Nature of Animals: I ſay, I have ſeen both Hexapode Worms (which I compare to the tender Embryo's of ſanguineous Animals, becauſe ſuch are in a middle State) and Flies of divers Sorts, hard frozen in the Winter, and I have taken them up from the Snow, and if I caſt them againſt the Glaſs, they would endanger the breaking of it, and make it ring like ſo much hard Ice; yet when I put the Inſects under the Glaſs, and ſet them before the Fire, they would, after a ſhort Time, nimbly creep about, and be gone, if the Glaſs which I whelmed upon them, had not ſecured them.

2. It hath indeed been noted by a very wiſe Philoſopher, in Contradiction to our *Engliſh* Proverb, which ſays, that *A green Chriſtmas makes a fat Church-yard*; that the laſt Plague broke out here at *London*, after a long and ſevere Winter 1665. But I reply, That that was accidentally only; for that Diſeaſe is never bred amongſt us, but comes to us by Trade and Infection. Tis properly a Diſeaſe of *Aſia*, where it is Epidemical. And therefore, by the Providence of God, we are very ſecure from any ſuch Calamities as the natural Effect of our Climate. But we are not to judge or prognoſticate of the Salubrity or Sicklineſs of a Year, from foreign Diſeaſes, but the raging of ſuch as are natural to the Men of our Climate.

By Mr Edm. Halley, n. 181. p. 110. 2. To account for the different Heights of Mercury at ſeveral times, 'twill not be unneceſſary to enumerate ſome of the principal Obſervations made upon the Barometer.

The firſt is, That in calm Weather, when the Air is inclined to Rain, the Mercury is commonly low.

2. That in ſerene good ſettled Weather, the Mercury is generally high.

3. That upon very great Winds, tho' they be not accompanied with Rain, the Mercury ſinks loweſt of all, with relation to the Point of the Compaſs the Wind blows upon.

4. That, *Cæteris Paribus*, the greateſt Heights of the Mercury are found upon Eaſterly, and North-eaſterly Winds.

5. That in calm froſty Weather the Mercury generally ſtands high.

6. That after very great Storms of Wind, when the Quick-ſilver has been low, it generally riſes again very faſt.

7. That the more northerly Places have greater Alterations of the Baroſcope than the more ſoutherly.

8. That within the *Tropicks*, and near them, thoſe Accounts we have had from others, and my own Obſervations at St. *Helena*, make very little or no Variation of the Height of the Mercury in all Weathers.

Hence I conceive, that the principal Cauſe of the Riſe and Fall of the Mercury, is from the variable Winds, which are found in the *Temperate Zones*, and whoſe great Unconſtancy here in *England*, is moſt notorious.

A ſecond Cauſe is the uncertain Exhalation and Precipitation of the Vapours lodging in the Air, whereby it comes to be at one Time much more crouded than at another, and conſequently heavier; but this latter, in a great meaſure, depends upon the former. Now from theſe Principles, I ſhall endeavour to explicate the ſeveral *Phænomena* of the Barometer, taking them in the ſame Order I laid them down. Thus,

1. The Mercury's being low, inclines it to Rain, becauſe the Air being light, the Vapours are no longer ſupported thereby, being become ſpecifically heavier than the Medium wherein they floated, ſo that they deſcend towards the Earth, and in their Fall, meeting with other aqueous Particles, they in-

corporate together, and form little Drops of Rain; but the Mercury's being at one time lower than another, is the Effect of two contrary Winds blowing from the Place where the Barometer ſtands; whereby the Air of that Place is carried both ways from it, and conſequently the incumbent Cylinder of Air is diminiſhed, and accordingly the Mercury ſinks; as for Inſtance, if in the *German Ocean* it ſhould blow a Gale of weſterly Wind, and at the ſame time an eaſterly Wind in the *Iriſh* Sea; or if in *France* it ſhould blow a northerly Wind, and in *Scotland* a ſoutherly; it muſt be granted me that that Part of the Atmoſphere impendent over *England*, would thereby be exhauſted and attenuated, and the Mercury would ſubſide, and the Vapours, which before floated in thoſe Parts of the Air of equal Gravity with themſelves, would ſink to the Earth.

2. The greater Height of the Barometer is occaſioned by two contrary Winds blowing towards the Place of Obſervation, whereby the Air of other Places is brought thither and accumulated; ſo that the incumbent Cylinder of Air being encreaſed both in Height and Weight, the Mercury preſſed thereby muſt needs riſe and ſtand high, as long as the Winds continue ſo to blow; and then the Air being ſpecifically heavier, the Vapours are better kept ſuſpended, ſo that they have no Inclination to precipitate and fall down in Drops; which is the Reaſon of the ſerene good Weather, which attends the greater Heights of the Mercury.

3. The Mercury ſinks the loweſt of all by the very rapid Motion of the Air in Storms of Wind. For the Tract or Region of the Earth's Surface, wherein theſe Winds rage, not extending all round the Globe, that ſtagnant Air which is left behind, as likewiſe that on the Sides, cannot come in ſo faſt as to ſupply the Evacuation made by ſo ſwift a Current; ſo that the Air muſt neceſſarily be attenuated when and where the ſaid Winds continue to blow, and that more or leſs, according to their Violence; add to which, that the *Horizontal* Motion of the Air being ſo quick, as it is, may, in all Probability, take off ſome Part of the perpendicular Preſſure thereof; and the great Agitation of its Particles is the Reaſon why the Vapours are diſſipated, and do not condenſe into Drops ſo as to form Rain, otherwiſe the natural Conſequence of the Airs Rarefaction.

4. The Mercury ſtands the higheſt upon an Eaſterly or North-eaſterly Wind, becauſe in the great *Atlantick Ocean*, on this ſide the 35th *Deg.* of North Latitude, the Weſterly and South-weſterly Winds blow almoſt always Trade; ſo that whenever here the Wind comes up at Eaſt and North-eaſt, 'tis ſure to be check'd by a contrary Gale, as ſoon as it reaches the Ocean; wherefore, according to what is made out in our ſecond Remark, the Air muſt needs be heaped over this Iſland, and conſequently the Mercury muſt ſtand high as often as theſe Winds blow. This holds true in this Country, but is not a general Rule for others where the Winds are under different Circumſtances; and I have ſometimes ſeen the Mercury here as low as 29 Inches upon an Eaſterly Wind, but then it blew exceeding hard, and ſo comes to be accounted for by what was obſerved upon the third Remark.

5. In Calm Froſty Weather the Mercury generally ſtands high, becauſe (as I conceive) it ſeldom freezes but when the Winds come out of the

Northern and North-eaſtern Quarters, or at leaſt unleſs thoſe Winds blow at no great Diſtance off; for the Northern Parts of *Germany*, *Denmark*, *Sweden*, *Norway*, and all that Tract from whence North-eaſtern Winds come, are ſubject to almoſt continual Froſt all the Winter; and thereby the lower Air is very much condenſed, and in that State is brought hitherwards by thoſe Winds, and being accumulated by the Oppoſition of the weſterly Wind blowing in the *Ocean*, the Mercury muſt needs be preſt to a more than ordinary Height; and as a concurring Cauſe, the ſhrinking of the lower Parts of the Air into leſſer Room by Cold, muſt needs cauſe a Deſcent of the upper Parts of the Atmoſphere, to reduce the Cavity made by this Contraction to an *Æquilibrium*.

6. After great Storms of Wind, when the Mercury has been very low, it generally riſes again very faſt; I once obſerved it to riſe 1½ Inch in leſs than 6 Hours after a long continu'd Storm of South-weſt Wind. The Reaſon is, becauſe the Air being very much rarified, by the great Evacuations which ſuch continued Storms make thereof, the Neighbouring Air runs in the more ſwiftly to bring it to an *Æquilibrium*; as we ſee Water runs the faſter for having a great Declivity.

Equilibre des Liquers. 7. The Variations are greater in the more Northerly Places, as at *Stockholm* greater than at *Paris* (compared by Mr. *Paſcall*) becauſe the more Northerly Parts have uſually greater Storms of Wind than the more Southerly, whereby the Mercury ſhould ſink lower in that Extream; and then the Northerly Winds bringing the condenſed and ponderous Air from the Neighbourhood of the *Pole*, and that again being checked by a Southerly Wind at no great Diſtance, and ſo heaped, muſt of Neceſſity make the Mercury in ſuch Caſe ſtand higher in the other Extream.

8. Laſtly, This Remark, That there is little or no Variation near the *Equinoctial*, does above all others confirm the *Hypotheſis* of the variable Winds being the Cauſe of theſe Variations of the Height of the Mercury; for in the Places above named there is always an eaſy Gale of Wind blowing nearly upon the ſame Point, *viz.* *E. N. E.* at *Barbadoes*, and *E. S. E.* at St. *Helena*; ſo that there being no contrary Currents of the Air to exhauſt or accumulate it, the Atmoſphere continues much in the ſame State: However, upon Hurricanes (the moſt violent of Storms) the Mercury has been obſerved very low, but this is but once in two or three Years, and it ſoon recovers its ſettled State, about 29½ Inches.

The principal Objection againſt this Doctrine is, that I ſuppoſe the Air ſometimes to move from thoſe Parts where it is already evacuated below the *Æquilibrium*, and ſometimes again towards thoſe Parts where it is condenſed and crouded above the mean State; which may be thought contradictory to the Laws of *Staticks* and the Rules of the *Æquilibrium* of Fluids. But thoſe that ſhall conſider how, when once an *Impetus* is given to a Fluid Body, it is capable of mounting above its Level, and checking others that have a contrary Tendency to deſcend by their own Gravity, will no longer regard this as a material Obſtacle; but will rather conclude, That the great Analogy there is between the Riſing and Falling of the Water upon the *Flux* and *Reflux* of the Sea, and this of accumulating and extenuating the

Air, is a great Argument for the Truth of this *Hypotheſis*. For as the Sea, over againſt the Coaſt of *Eſſex* riſes and ſwells by the meeting of the two contrary Tides of Flood, whereof the one comes from the *S. W.* along the *Channel* of *England*, and the other from the North; and, on the contrary, ſinks below its Level upon the Retreat of the Water both ways, in the Tide of Ebb; ſo it is very probable, that the Air may Ebb and Flow after the ſame manner; but by reaſon of the Diverſity of Cauſes, whereby the Air may be ſet in moving, the Times of theſe *Fluxes* and *Refluxes* thereof are purely caſual, and not reducible to any Rule, as are the Motions of the Sea, depending wholly upon the regular Courſe of the *Moon*.

The Cauſe of the Suſpenſion of the Mercury at an unuſual Height; by Mr. Hugens, n. 86. p. 5027.

XI. 1. The Experiment is briefly this; That a Tube being after the *Torricellian* Way filled with Mercury, and before Inverſion perfectly purged of Air, doth, when inverted, remain top full, even to the Height of 75 Inches.

Mr. *Hugens*, to render a probable Cauſe of this ſtrange Effect, conceiveth, That beſides the Preſſure of the Air which keeps the Mercury ſuſpended at the Height of about 27 Inches, (and of the Truth of which we are convinced by a great Number of other Effects that we ſee) there is yet another Preſſure, ſtronger than that, of a more ſubtile Matter than Air, which without Difficulty penetrates Glaſs, Water, Quick-ſilver, and all other Bodies, which we find impenetrable to Air. This Preſſure, he ſaith, being added to that of the Air, is capable to ſuſtain the 75 Inches of Mercury, and poſſibly more, as long as it works only againſt the lower Surface, or againſt that of the Mercury, in which ſtands the open End of the Tube: But as ſoon as it can work alſo on the other ſide, (which happens when ſtriking or hitting againſt the Tube, or intromitting into it a ſmall Bubble of Air, you give way to this Matter to begin to act) the Preſſure of it becomes equal on both Sides, ſo that there is no more but the Preſſure of the Air which ſuſtains the Mercury at the ordinary Height of 29 Inches.

If you ask, why the Quick-ſilver in the Tube of this Experiment does not feel the Preſſure of this Matter, even whilſt that Veſſel is yet full; ſince Mr. *Hugens* ſuppoſeth, that it pierceth without Difficulty the Glaſs as well as the Mercury, &c. and why the Particles of this Matter do not join together and begin the Preſſure, in regard that they go and come thorough the whole Extent of the Mercury, and that the Glaſs does not hinder their Communication with thoſe that are without?

To remove this Difficulty, which in Mr. *Hugens*'s own Opinion is very great, he anſwers, That though the Parts of the Matter by him ſuppoſed do find Paſſage between thoſe that compoſe the Glaſs, Quick-ſilver, &c. yet they there find not ſufficiently large ones for many to paſs together, nor to move there with that Force which is requiſite to ſeparate the Parts of the Quickſilver, that have ſome Connexion together. And this very ſame Connexion, he ſaith, is the Cauſe that though on the Side of the inner Surface of the Glaſs, which touches the ſuſpended Mercury, many of its Parts be preſſed by the Particles of this Matter; yet there being alſo a great Number of them that feel no Preſſure, by reaſon of the Parts of the Glaſs, behind which they are placed, they retain one another, and they remain all ſuſpended, becauſe there is much leſs Preſſure on the Surface of the Quick-ſilver that is contiguous to the Glaſs; than upon that below, which is all expoſed to the Action of that Matter which makes this ſecond Preſſure.

The ingenious and candid Author of this Solution acknowledges himſelf, That it doth not ſo fully ſatisfy him, as not to leave ſome Scruple behind; but then he adds, That that keeps him not from being very well aſſured of that new Preſſure, which he hath ſuppoſed beſides that of the Air, by reaſon as well of the Experiment already alledged, as of two others; which he ſubjoins, to this Effect.

Firſt, When two Plates of Metal or Marble, whoſe Surfaces are perfectly plain, are put one upon another, they do ſo ſtick together, that the uppermoſt being lifted up, the undermoſt follows without quitting it; and the Cauſe hereof is juſtly aſcribed to the Preſſure of the Air against their two external Surfaces. He taking then two Plates, each of them but about an Inch ſquare, being of that Matter of which anciently they made Looking-Glaſſes, and cloſing them ſo exactly together, that without putting any Thing between, the uppermoſt keeps not only up the other, but ſometimes alſo with it 3 Pounds of Lead faſten'd to the lowermoſt; and thus they remain together as long as you pleaſe. Having thus joined them, and charged them with 3 Pounds weight, he ſuſpended them in the Recipient of his Engine, and exhauſted it of Air ſo far as that there remained not enough to ſuſtain by its Preſſure as much as an Inch Height of Water, and yet his Plates disjoined not. He adds, that he made the ſame Experiment by putting Spirit of Wine between the two Plates, and found that in the Recipient evacuated of Air they ſuſtained, without being ſevered, the ſame Weight they did when it was full of Air. This he thinks ſhews clearly enough, that there remains yet in the Recipient a Preſſure great enough, after that of the Air is thence taken away; and that there is no more Reaſon to doubt of it, than of the Preſſure of the Air itſelf.

The *Second* Experiment is, That whereas the Effect of a Siphon of unequal Legs, by which you make the Water of a Veſſel to run over, is no longer aſcribed to *Fuga Vacui*, but to the Weight of the Air, which preſſing upon the Water of the Veſſel makes it riſe in the Siphon, whilſt on the other Side it deſcends by its Weight; Mr. *Hugens* found a Means to make the Water of the Siphon run after that the Recipient was exhauſted of Air, and he ſaw that with Water purged of Air it did the Effect as well as without the Recipient. The ſhorteſt of the Legs of the Siphon was 8 Inches long, and its Aperture of two Lines. And he will not have us doubt whether the Recipient was well exhauſted of Air, for he did aſſure himſelf of that, as well by finding that there came out no more Air through the Pump, as by other more certain Marks.

And this he takes for a farther Confirmation of his Suppoſition of a preſſing Matter more ſubtile than the Air. To which he adds, That if you take the Pains of ſearching to what Degree the Force of this Preſſure reacheth (which he ſaith cannot be better made than by purſuing the Experiment with Tubes full of Mercury, yet longer than thoſe employed by Mr. *Boyle*) it will perhaps be found, that this Force is great enough to cauſe the Union of the parts of Glaſs, and of other Sorts of Bodies, which hold too well together, not to be conjoined but by their Contiguity and Reſt, as M. *Des Cartes* would have it.

By Dr. J. Wallis, n. 91. p. 5160

2. I have given an Account of this odd *Phænomenon* in my Treatiſe *de Motu, Cap.* 14. *Schol. Prop.* 13. where I hinted two Reaſons (though not perfectly ſatisfied in either:) The one of my own, concerning the Spring of the Air neceſſary to put heavy Bodies in Motion, not impelled by any other Force: The other of my Lord *Brounker*, That there might be in the Air yet a greater Weight or Preſſure than is neceſſary for the Height of 29 Inches, in caſe there be nothing but the bare Weight of Quick-ſilver to be ſupported. I find Mr. *Hugens* to fall in with that of my Lord *Brounker*, ſave that what we comprehend under the Name of Air, he calls a more ſubtile Matter; which alters not the Caſe at all, but only the Name.

But ſurely there muſt be ſomewhat more than this ſubtile Matter, to ſolve the *Phænomenon*, notwithſtanding the two Experiments now alledged by Mr. *Hugens* in favour of it; for, if this Matter be ſo ſubtile as to preſs through the Top of the Glaſs upon the Quick-ſilver, (and conſequently through the Upper upon the Nether of the two Marbles) as is acknowledged (and without which it is no more able to precipitate the Quick-ſilver while impure, and when it is in part ſubſided, that when it is pure, and the Tube top full:) I do not ſee, why it ſhould not balance itſelf (above and below) in the ſame manner as common Air would do, if the Tube were pervious to it at both Ends, and the Quick-ſilver, by the Preponderance of its own Weight fall preſently. And the Anſwer, That though Glaſs be penetrated by it, yet not in ſo copious a manner as where no Glaſs is, doth not to me ſolve the Difficulty; becauſe the ſame Obſtacle doth juſt in the ſame manner remain, when the Tube is in part emptied, and when the Quick-ſilver is unpurged; the Pores of the Glaſs not being, by either of thoſe, made more open or more pervious. And if we ſuppoſe the ſubtile Matter by Percolation to be ſtrained through with ſome Difficulty, (as Air or Water would be through a Cloth) this might poſſibly cauſe the Quick-ſilver, when it does ſink, to ſink gradually; but not (as we ſee it) ſuddenly to fall to the Height of 29 Inches.

The Connexion or Coheſion of the Parts of Quick-ſilver, either each to other, or to the Sides of the Glaſs, which Mr. *Hugens* ſuppoſeth to require for their Separation a greater Force than is in theſe percolated Particles, till they have Room made for them to combine; ſeems to me the leſs conſiderable, becauſe it is not ſo neceſſary to ſeparate them from each other, ſince they may unſeparated ſlide down by the Sides of the Glaſs, to which it is well known, and viſible to the Eye, the Quick-ſilver is not at all apt to ſtick, but doth rather decline that Contact; in like manner as we find Water not apt to join with Oil or Greaſe, though Water to Glaſs, and Quick-ſilver to Gold, do very readily apply themſelves. So that there needs no ſuch Force to diſjoin the Quick-ſilver from the Glaſs, whatever there may be for disjoining its Parts one from another.

If therefore we ſhould ſuppoſe the Preſſure of the groſſer Air downwards on *A B* (the Surface of the ſtagnant Quick-ſilver), and conſequently by means thereof upwards at *C*, ſufficient only to bear up that in the Tube to the Height of *I*; but the ſuperadded Weight or Preſſure of the purer Air to hold it up as high as *D*, (75 Inches or more) while it is full

Fig. 7.

and the Quick-ſilver well cleanſed, as if ſo long it could not enter at *D*; but in caſe it be not ſo cleanſed, or be already ſunk to *H*, this purer Air would enter at *D*, and thruſt it down to *I*, counter-balancing the Preſſure (at *C*) of the purer, but not of the groſſer Air (which I take to be the Sum of the Cauſe aſſign'd by Mr. *Hugens* :) I am yet to ſeek, why it may not as well penetrate *D* at firſt, to begin the Deſcent, as afterwards to purſue it; and why not as well begin the Deſcent when the Quick-ſilver is well cleanſed of Air, as when it is not ſo; and why alſo, if the pure Air do freely enter at *D*, it does not preſently fall; or, if not freely, why, when it does fall, it falls ſuddenly, and not leiſurely, from *D* to *I*; eſpecially ſince ſo ſmall a Weight as *D H* of pure Air (for the groſſer cannot enter) is very inconſiderable; if not at all, or not freely, preſſed by that incumbent on *D*; and the Adheſion not conſiderably leſs, by being ſeparated only at the Top, while it yet continues to touch the Sides.

I am apt therefore, as heretofore, to aſcribe the Cauſe of this *Phænomenon* to the Spring that is in Air, and the want thereof in Quick-ſilver; for, that in Air there is a Spring or Elaſticity, is now undoubted; but in Water cleanſed of Air, though many Experiments have been attempted to that purpoſe, it has not yet been found that there is any: And I am apt to think the like of Quick-ſilver, though I do not know that this has been yet ſo rigorouſly examin'd. Now ſuppoſing, That Matter being at Reſt will ſo continue till it be put in Motion by ſome Force; this Force may be either that of Percuſſion from ſome Body already in Motion (which is the Caſe when the Quick-ſilver falls by ſhaking or ſtriking the Tube) or of Pulſion from a contiguous Body beginning to move, as by the Expanſion of ſome adjacent Spring (which is the Caſe when the ſpringy Parts of the Air, either left in unpurged, or re-admitted in the Quick-ſilver, by expanding themſelves put the Quick-ſilver in Motion;) or ſome *Conatus* or Endeavour of its own, ſuch as is that of a Spring, from whatever Cauſe it be, which I do not here enquire, but has place only in Springy Bodies; and therefore if Water and Quick-ſilver be not ſuch, they will not on this account put themſelves in Motion.

Gravity or Heavineſs is reputed to be ſuch a *Conatus* or Pronity to move downwards, and ſo to put itſelf in Motion; and the Wonder at preſent is, why it does not ſo here. But if this which we call Gravity ſhould chance to be not a poſitive Quality or *Conatus* originally of itſelf, but only the Effect of ſome Pulſion or Percuſſion from without (which poſſibly may be the Caſe, and principally from the Spring of the Air about us) then while this Pulſion and Percuſſion is wanting (however obviated) the Bodies accounted heavy, will not of themſelves begin to fall; which ſeems to be the preſent Caſe.

And this is the more conſiderable, becauſe we cannot, at leaſt not yet, find, what is the utmoſt Height at which the Quick-ſilver thus accumulated will remain ſuſpended; there having been, for ought I know, no Height yet attempted, at which, if cleanſed, it will not ſtand; and that of 75 Inches, conſidering the Weightineſs of Quick-ſilver, is a very great one, being more than equivalent to 80 Foot of Water.

My Lord *Brounker* doth a little alter the Caſe from what I take to be the *Hypotheſis* of Mr. *Hugens*; for he ſuppoſeth this purer Part of the Air to be of like Nature with the groſſer Part (which I think Mr. *Hugens* doth not) and, though finer than the reſt, ſo as to penetrate Glaſs, which the groſſer will not (there being in all ſorts of Grains, ſome greater than others, and which will not paſs ſo fine a Sieve) yet of a ſpringy Nature, as the groſſer Parts are; which therefore acts, not by its Weight only, but by its Spring; and therefore when once entered, though in a ſmall Proportion, acts as effectually at its firſt Entrance as if the whole incumbent Air had Admiſſion, its Spring being of a like Tenſure with that of the outward Air, (as I have heretofore ſhewed, *Cap.* 14. *De Motu*, *Prop.* 11, 12, 13.) but Mr. *Hugens*'s more ſubtile Matter than Air, though he muſt allow it Weight, for elſe its Entrance would be nothing to the purpoſe; yet whether he allow it a Spring, I cannot tell; nor doth he inform us. And when he ſays, this more ſubtile Matter than Air doth without Difficulty penetrate Glaſs, Water, Quick-ſilver, and all other Bodies, which we find impenetrable to Air, I know not whether he mean, without any Difficulty, as the Words ſeem to import; or, as I conjecture by what follows, without great Difficulty, though with ſome.

But his *Lordſhip*, if I miſtake not, though he allows his ſpringy, ſubtile Matter to penetrate Glaſs, yet not without Difficulty; and till it have ſome Room made, as at *HD*, wherein it may recollect itſelf, cannot exert its Spring; and therefore not while top full of cleanſed Quick-ſilver, but ſo ſoon as ſome Room is made for it; whereas if the Quick-ſilver be not purged of Air, that little Air remaining doth by its Spring begin the Motion.

He thinks it alſo not improbable, and if it ſo prove, it will be a good Confirmation of this *Hypotheſis*, That a large but low Tube of Glaſs (ſhorter than 29 Inches) may ſtand top full of Quick-ſilver, though with a ſmall Hole in the Top, as at *K*; at leaſt if immerged in Water, in caſe Air be too ſubtile for our Mechanicks.

He might alſo, ſuitably enough to his own *Hypotheſis*, have ſo explained himſelf as to allow his more ſubtile Parts of common Air to penetrate Quick-ſilver, but not Glaſs; and therefore, in caſe of Room for it at *HD*, it might through the ſtagnant Quick-ſilver, and that at *C*, paſs upwards to *HD*, and there exert its Spring.

There is yet another way of explicating the ſame *Hypotheſis*, without allowing this ſubtile Matter to pierce the Glaſs; which is this: Our common Air being an Aggregate of very heterogeneous Parts, we may well ſuppoſe ſome of them to be Springy, and others not to be ſo. The ſpringy Parts we may conceive to be ſo many conſiſtent Bodies, like ſmall Hairs or ſpringy Threads wrapped up in different Forms and variouſly intangled, and ſo as to form many Vacuities, capable of admitting (what the other Parts of the Air may be ſuppoſed to be) ſome fluid Matter, which may inſinuate into thoſe Vacuities (as Water in a Bundle of Ruſhes) without diſturbing the Texture of thoſe ſpringy Parts; and which may preſs as a Weight, but not as a Spring (Of which Diſtinction ſee *Cap.* 14. *De Motu*, *Schol.* *Prop.* 11. & *Schol.* *Prop.* 13. p. 729, 730, 731, 733.) Now if in the *Torricellian* Tube there be a Quantity of ſuch ſpringy Matter, the Spring hereof will be of equal ſtrength with that of external Air, (and therefore able to counterbalance it, though its Weight be much leſs) becauſe admitted with ſuch a Tenſure, (*ibid. Prop.* 12, 13.) But if only an unſpringy Fluid (which preſſeth but as a Weight not as a Spring) and this defended by the Glaſs Tube from any other Preſſure, ſave that of its own Weight, it will ſtill be too weak to force its own way, till its ſingle Weight be equivalent to that which it is to encounter; which is not only the ſpringy Part of the Air, but alſo that fluid unſpringy Part; which though (becauſe fluid) it would give way to a ſpringy Body preſſing through it, yet not to this fluid, like itſelf, and deſtitute of ſuch a Spring; and is therefore able to keep it up to a much greater Height than it could do if uncleanſed of ſpringy Air; ſo long, at leaſt, till ſome ſpringy Body be admitted, or ſome Concuſſion equivalent to it, put it in Motion; but being once in Motion, it will ſo continue (as a Bullet impelled by Gun-powder, or an Arrow out of a Bow) till ſtopped by ſome poſitive Force equivalent.

Vid. Inf. §. penult. I do not deny, but that this Explication may be ſubject to ſome Difficulties and Exceptions; but I think, fewer than that of allowing the Glaſs penetrable by this ſubtile Matter: But the beſt way to ſettle this Buſineſs is by ſuitable Experiments.

A Statical Baroſcope; by M. Boyle, n. 14. p. 231. XII. I cauſed to be blown at the Flame of a Lamp ſome Glaſs-Bubbles, as large, thin, and light, as I could then procure; and chuſing amongſt them one that ſeemed the leaſt unfit for my Turn (being of the Bigneſs of a ſomewhat large Orange, and weighing about 1 *Dr.* 10 *Gr.*) I counterpoiſed it in a Pair of Scales, that would loſe their *Æquilibrium* with about the 30th Part of a Grain, and were ſuſpended at a Frame. I placed both the Balance and the Frame by a good Baroſcope, from whence I might learn the preſent Weight of the Atmoſphere; then leaving theſe Inſtruments together, though the Scales being no nicer than I have expreſſed, were not able to ſhew me all the Variations of the Air's Weight that appeared in the Mercurial Baroſcope; yet they did what I expected, by ſhewing me Variations no greater than altered the Height of the Quick-ſilver half a Quarter of an Inch, and perhaps much ſmaller than thoſe. I had the Pleaſure to ſee the Bubble ſometimes in an *Æquilibrium* with the Counterpoiſe; ſometimes when the Atmoſphere was high, preponderate ſo manifeſtly, that the Scales being gently ſtirr'd, the Cock would play altogether on that ſide, at which the Bubble was hung; and at other Times (when the Air was heavier) that, which was at the firſt but the Counterpoiſe, would preponderate, and upon the Motion of the Balance make the Cock vibrate altogether on its ſide. And this would continue ſometimes many Days together, if the Air ſo long retained the ſame meaſure of Gravity; and then (upon other Changes) the Bubble would regain an *Æquilibrium*, or a Preponderance; ſo that I had oftentimes the Satisfaction, by looking firſt upon the ſtatical Baroſcope (as for Diſtinction's ſake it may be called) to foretel, whether in the Mercurial Baroſcope the Liquor were High or Low.

If the Ground on which I went in framing this Baroſcope, be demanded, the Anſwer in ſhort may be; 1. That though the glaſs Bubble, and the braſs Counterpoiſe, at the Time of their firſt being weighed, be in the Air, wherein they both are weighed, exactly of the ſame Weight; yet they are nothing near of the ſame Bulk, the Bubble by Reaſon of its capacious Cavity (which contains nothing but Air, or ſomething that weighs leſs than Air) being, perhaps, a hundred or two hundred Times bigger than the Metalline Counterpoiſe. 2. That according to the Hydroſtatical Laws, if two Bodies of equal Gravity, but unequal Bulk, come to be weighed in another Medium, they will be no longer equiponderant; but if the new Medium be heavier, the greater Body, as being lighter in Specie, will loſe more of its Weight than the leſſer and more compact; but if the new Medium be lighter than the firſt, then the bigger Body will out-weigh the leſſer: And this Diſparity ariſing from the Change of Mediums, will be ſo much the greater, by how much the greater Inequality of Bulk there is between the Bodies formerly equiponderant. 3. That, laying theſe two together, I conſider'd that 'twould be all one, as to the Effect to be produced, whether the Bodies were weighed in Mediums of differing Gravity, or in the ſame Medium, in Caſe its ſpecifick Gravity were conſiderably alter'd: And conſequently, that ſince it appeared by the Baroſcope, that the Weight of the Air was ſometimes lighter, the Alterations of it, in Point of Gravity, from the Weight it was of at firſt counterpoiſing of the Bubble of it, would unequally affect ſo large and hollow a Body as the Bubble, and ſo ſmall and denſe an one as a Metalline Weight: And when the Air, by an Encreaſe of Gravity, ſhould become a heavier Medium than before, it would buoy up the Glaſs more than the Counterpoiſe; and if it grew lighter than it was at firſt, would ſuffer the former to preponderate.

One Morning early, being told of a Miſt, I ſent to ſee whether it made the Air ſo heavy as to buoy up the Bubble; but I did not learn, that that Miſt had any ſenſible Operation on it.

Though a ſingle Bubble of competent Bigneſs be much preferable, by reaſon that a far leſs Quantity and Weight of Glaſs is requiſite to compriſe an equal Capacity, when the Glaſs is blown into a ſingle Bubble, than when it is divided into two; yet I found that the employing of two inſtead of one, did not ſo ill anſwer my Expectations, but that they may, for a Need, ſerve the Turn inſtead of the other, than which they are more eaſy to be procured: And if the Balance be ſtrong enough to bear ſo much Glaſs, without being injured, by employing two, or a greater Number of large Bubbles, the Effect may be more conſpicuous, than if only a ſingle Bubble (though a very good one) were employ'd.

This Inſtrument may be much improved by divers Accommodations. As,

1. There may be fitted to the *Anſa* (or Cheek of the Balance) an Arch of a Circle divided into 15 or 20 *Deg*. (more or leſs, according to the Goodneſs of the Balance) that the Cock, reſting over againſt theſe Diviſions, may readily, and without Calculation, ſhew the Quantity of the Angle, by which, when the Scales propend either Way, the Cock declines from the Perpendicular, and the Beam from its *Horizontal* Paralleliſm.

2. Thoſe that will be ſo curious, may, inſtead of the ordinary Counterpoiſe (of Braſs) employ one of Gold, or at leaſt, of Lead; whereof the latter being of equal Weight with Braſs, is much leſs in Bulk, and the former amounts not to half its Bigneſs.

3. Thoſe Parts of the Balance, that may be made of Copper or Braſs, without any Prejudice to the Exactneſs, will, by being made of one of thoſe Metals, be leſs ſubject than Steel (which yet, if well hardened and poliſhed, may laſt good a great while) to ruſt with long ſtanding.

4. Inſtead of the Scales, the Bubble may be hung at one End of the Beam, and only a Counterpoiſe to it at the other; that the Beam may not be burdened with unneceſſary Weight.

5. The whole Inſtrument, if placed in a ſmall Frame, like a ſquare Lanthorn, with Glaſs Windows, and a Hole at the Top, for the Commerce of the internal and external Air, will be more free from Duſt, and irregular Agitations; to the latter of which it will otherwiſe be ſometimes incident.

6. This Inſtrument being accommodated with a light Wheel, and an Index (ſuch as have been applied, by the excellent Dr. *Chr. Wren*, to open Weather-Glaſſes, and by the ingenious Mr. *Hook*, to Baroſcopes) may be made to ſhew much more minute Variations than otherwiſe.

7. And the Length of the Beam, and Exquiſiteneſs of the Balance, may eaſily, without any of the foregoing Helps (and much more with them) make the Inſtrument far exacter than any of thoſe I was reduced to employ. And to theſe Accommodations divers others may be ſuggeſted, by a farther Conſideration of the Nature of the Thing, and a longer Practice.

Though, in ſome Reſpects, this ſtatical Baroſcope be inferior to the Mercurial; yet in others, it has its own Advantages and Conveniencies above it.

And, 1. It confirms, *ad Oculum*, our former Doctrine, That the Falling and Riſing of the Mercury depends upon the varying Weight of the Atmoſphere; ſince in this Baroſcope it cannot be pretended, that a *Fuga Vacui*, or a *Funiculus*, is the Cauſe of the Changes we obſerve. 2. It ſhews, that not only the Air has Weight, but a more conſiderable one than ſome learned Men, who will allow me to have proved it has ſome Weight, will admit; ſince even the Variation of Weight, in ſo ſmall a Quantity of Air, as is but equal in Bulk to an Orange, is manifeſtly diſcoverable upon ſuch Balances as are none of the niceſt. 3. This ſtatical Baroſcope will oftentimes be more parable than the other; for many will find it more eaſy to procure a Pair of good Gold Scales, and a Bubble or two, than a long Cane ſeal'd, a Quantity of Quickſilver, and all the other Requiſites of the Mercurial Baroſcope; eſpecially if we comprize the Trouble and Skill that is requiſite to free the deſerted Part of the Tube from Air. 4. And whereas the Difficulty of removing the Mercurial Inſtrument has kept Men from ſo much as attempting to do it, even to neighbouring Places; the eſſential Parts of the Scale Baroſcope (for the Frame is none of them) may very eaſily, in a little Room, be carried whether one will, without the Hazard of being ſpoiled or injured. 5. There is not in ſtatical Baroſcopes, as in the other, a Danger of Uncertainty, as to the Goodneſs of the Inſtruments, by Reaſon that in theſe the Air is in ſome more, and in ſome leſs perfectly excluded; whereas in thoſe, that Conſideration has no Place. (And by the way, I have ſometimes, upon this Account, been able to diſcover, by our new Baroſcope, that an eſteemed Mercurial one, to which I compared it, was not well freed from Air.) 6. It being very poſſible to diſcover Hydroſtatically, both the Bigneſs of the Bubble, and the Contents of the Cavity, and the Weight and Dimenſions of the Glaſſy Subſtance (which, together with the included Air, make up the Bubble) much may be diſcover'd by this Inſtrument, as to the Weight of the Air, abſolute or reſpective. For when the Quick-ſilver in the Mercurial Baroſcope is either very high or very low, or at a middle Station, between its greateſt and leaſt Height, bringing the Scale Barometer to an exact *Æquilibrium* (with very minute Diviſions of a Grain) you may, by watchfully obſerving when the Mercury is riſen or fallen juſt an Inch, or a fourth, or half an Inch, *&c.* and putting in the like minute Diviſions of a Grain, to the lighter Scale, till you have again brought the Balance to an exquiſite *Æquilibrium*; you may, I ſay, determine what known Weight, in the ſtatical Baroſcope, anſwers ſuch determinate Altitudes of the aſcending and deſcending Quick-ſilver in the Mercurial. And if the Balance be accommodated with a divided Arch, or a Wheel and Index, theſe Obſervations will aſſiſt you for the future, to determine readily, by ſeeing the Inclination of the Cock, or the Degree marked by the Index, what Pollency the Bubble hath, by the Change of the Atmoſphere's Weight, acquired or loſt. 7. By this ſtatical Inſtrument we may be aſſiſted to compare the Mercurial Baroſcopes of ſeveral Places (though never ſo diſtant) and to make ſome Eſtimates of the Gravities of the Air therein. As if, for Inſtance, I have found, by Obſervation, that the Bubble I employ'd, weigh'd juſt a *Drachm*, when the Mercurial Cylinder was at the Height of 29 ½ Inches (which in ſome Places I have found a moderate Altitude) and that the Addition of the 16th Part of a *Gr.* is requiſite to keep the Bubble in an *Æquilibrium*, when the Mercury is riſen an 8th, or any determinate Part of an Inch above the former Station: When I come to another Place, where there is a Mercurial Barometer, as well freed from Air as mine (for that muſt be ſuppoſed) if taking out my Scale Inſtrument, it appears to weigh preciſely a *Drachm*, and the Mercury in the Baroſcope ſtand at juſt 29 ½ Inches, we may conclude the Gravity of the Atmoſphere not to be ſenſibly unequal in both theſe two Places, though very diſtant. And though there be no Baroſcope there, yet, if there be an Addition of Weight, as for Inſtance, the 16th Part of a Grain, requiſite to be added to the Bubble, to bring the Scales to an *Æquilibrium*, it will appear, that the Air, at this ſecond Place, is at that Time ſo much heavier than the Air of the former Place was, when the Mercury ſtood at 29 ½ Inches.

But in making ſuch Compariſons, we muſt not forget to conſider the Situation of the ſeveral Places; if we mean to make Eſtimates, not only of the Weight of the Atmoſphere, but of the Weight and Denſity of the Air. For though the Scales will ſhew, as has been ſaid, whether there be a Difference of Weight in the Atmoſphere at the two Places; yet if one of them be in a Vale or Bottom, and the other on the Top, or ſome elevated Part of a Hill, it is not to be expected, that the Atmoſphere, in this latter Place, ſhould gravitate as much as the Atmoſphere in the former, on which a longer Pillar of Air does lean or weigh.

And the Mention I have made of the differing Situation of Places, puts me in Mind of ſomething that may prove another Uſe of our ſtatical Baroſcope;

roſcope; namely, that by exactly poiſing the Bubble at the Foot of a high Steeple, or Hill, and carrying it in its cloſe Frame to the Top, one may, by the Weight requiſite to be added to the Counterpoiſe there, to bring the Beam to its *Horizontal* Poſition, obſerve the Difference of the Weight of the Air at the Bottom, and at the Top; and in Caſe the Hill be high enough, at ſome intermediate Stations: And, perhaps, when duly improv'd, it may aſſiſt Men to eſtimate the abſolute or comparative Height of Mountains, and other elevated Places of the Earth.

The Uſe of Barometers; by —— n. 122. p. 593.

XIII. By accurate Baroſcopes we may regain that Knowledge which ſtill reſides in Brutes, and we forfeited by not continuing in open Air, as they do for the moſt Part, and by Intemperance corrupting the Craſis of our Senſes.

Thermometers and Obſervations made with them; by Dr. J. Beal, n. 55. p. 1114.

XIV. 1. *Dec.* 26, 1669. in the Morning, the Weather was colder than ever I found it, ſince I could take it by the Meaſure of a Thermometer; that is ſince theſe 5 or 6 Years. It was very cold, and freezing quick ſome Days before and after: And yet, in this Time the Mercury hath ſometimes fallen more than an Inch, without any other Change of Weather than ſome Guſts of Winds, ſome Sprinklings of Snow at ſeveral Times, in all ſcarce enough to cover the Ground; and ſome Abatements of Cold, more eſpecially when the Sun was up. To note this Degree of Cold more particularly, I muſt acquaint you, that in my ſtanch Thermometer, on the ſaid 26th of *December*, the Liquor was at $3\frac{1}{2}$ Inches: Whereas, in ordinary briſk Froſts, it is at 7 Inches. Yet here I muſt obſerve, that ſometimes the Froſt diſſolves, when it is at the 7th Figure; and ſometimes I find it at the 8th Figure, in a ſmart Froſt. 'Tis warm *May* Weather when 'tis at the 10th Figure; and 'tis not much above the 12th Figure in the hotteſt Weather of *June*, *July*, and *Auguſt*.

I think it remarkable, that the 7th Inch, and ſometimes the 8th, in my Thermometer, ſhould abide freezing, and the Froſt increaſe, till the Liquor deſcend $4\frac{1}{2}$ Inches; and yet that it ſhould not aſcend from the 8th Inch more than $4\frac{1}{2}$ Inches in our hotteſt Summer, being hung in the ſame Place, within 18 Inches of the Glaſs Window, facing the North-weſt, and in a little Writing Room, in the 2d Row of Buildings. But now I am ſtrongly perſuaded, that the Degrees of Heat and Cold are not exactly indicated by the incloſed Spirit of Wine: For when the Snow melted, and the Froſt was firſt diſſolved, without Sun-ſhine, the Liquor was not above the Height of $5\frac{1}{2}$ Inches; poſſibly it retains ſome Part of the Cold a while after the ambient Air becomes more tepid.

By Dr. J. Willis, n 55. p. 1118.

2. My Thermoſcope was firſt made in *Dec.* 1664. The whole Height of the ſmall Cylindrick Glaſs, whoſe Cavity was about $\frac{1}{8}$ of an Inch Diameter, was about 28 Inches; beſides a ſmall Spherical Bowl at the Top, of about $\frac{1}{4}$ of an Inch Diameter, and a Bowl at the Bottom, which contained the Liquor (being Spirit of Wine tinged with Cochineal) of about 2 Inches Diameter: The Space above the Liquor being, at the firſt Compoſure of it, void of Air, ſave what it had out of the Liquor; which being warm at the firſt putting in, filled the whole Cavity, while the Glaſs was Hermetically ſeal'd. I placed it ſo, as never to be expoſed to the Sun, but in a Room that has a Window only in the North; and therefore it gives an Account only of the Temperature

n. 10. p. 169.

Id. p. 167.

perature of the Air in general, not of the immediate Heat of the Sun-ſhine. It is ſo nice, as that my being or not being in my Study, I find to vary its Height ſometimes almoſt $\frac{1}{4}$ of an Inch.

The loweſt Mark to which the Liquor did ſubſide in *Jan.* and *Feb.* $166\frac{4}{5}$. was at $12\frac{1}{4}$ Inches: At $14\frac{1}{2}$ it was Froſt certain; and ſometimes at 15, and at $15\frac{1}{2}$ (yet this I often obſerved, that the Air by the Thermoſcope has appeared conſiderably colder, and the Liquor lower, or ſometimes when there was no Froſt, than at ſome other Times, when the Froſt hath been conſiderably hard:) The greateſt Height in the Summer following was at 25, 26, $26\frac{1}{2}$.

n. 55. p. 1118.

n. 10. p. 169.

In *Dec. Jan.* and *Feb.* 1665. we had at $14\frac{1}{2}$ Froſt certain; ſometimes at 15 or higher; and the loweſt, to which it did that Winter deſcend, was $12\frac{1}{4}$. The Height in the following Summer, 1666. was uſually about 19, 20, 21; the higheſt of all at 25.

n. 55. p. 1118.

In *Dec.* and *Jan.* 1666. it was Froſt certain, at about $13\frac{1}{2}$ (an Inch lower than the Years before; the Liquor, it ſhould ſeem, becoming leſs ſpirituous) ſometimes at 14 or $14\frac{1}{2}$: It was hard Froſty Weather at 12, 11, and once at $10\frac{1}{2}$; the Weather being very cold. The uſual Height in the Summer following, 1667. was about 19, 20, 21, and the higheſt at $24\frac{1}{2}$.

The Winter following, 1667. it was ſcarce certain Froſt at 13; but yet ſometimes at 14, or a little higher: The loweſt, to which it did deſcend that Winter (being very mild after *Chriſtmas*) was at 12. And the following Summer, 1668. uſually about 18, 19, 20; the higheſt of all (the Heat of that Summer being but very moderate) at 22.

The next Winter it was Froſt certain, about $12\frac{1}{2}$; but ſometimes at 13, or higher: the loweſt of all at $10\frac{1}{4}$. And in the Summer following, 1669. the higheſt of all (being but a cool Summer) not much above 20.

At *Chriſtmas*, 1669. though I found it to be Froſt certain about $12\frac{1}{4}$, and ſomething higher than 13; yet hath it come ſometimes lower than 8; and particularly *Dec.* 26, in the Morning, to $7\frac{1}{4}$; and did not all that Day come ſo high as 8 Inches: Which being ſo much lower than ever it had been in any of the precedent Years of my Obſervation, though it may, in part, be attributed to the diſpiriting of the Liquor, yet principally to the Extremity of the Cold. *Jan.* 1. when the Froſt ſeem'd to relent, it was ſomewhat higher than 9; and *Jan.* 7, about $13\frac{1}{2}$.

3. The greateſt Height the Spirit did riſe to in the Thermometer, was two Diviſions below extream Hot, when we were near the *Equinoctial*.

A Thermometer obſerved at Sea; by Mr. Ja. Cunningham, n. 264. p. 577.

XV. Since the ſame Degree of Heat does not proportionally expand all Fluids; ſome ſwelling with a gentle Warmth, and others not till they be conſiderably hot; ſome boiling with a moderate Heat, and others not at all; ſome capable of great Expanſion, others increaſing very little; it may well be concluded, that no one of them does increaſe and diminiſh in the ſame Proportion with the Heat, and conſequently, that the Thermometers graduated by equal Parts of the Expanſion of any Fluid, are not ſufficient Standards of Heat or Cold.

The Expanſion of ſeveral Fluids, in order to aſcertain the Diviſions of the Thermometer; by Mr. Edm. Halley, n. 197. p. 650.

This will be more evident from the Experiments which I made in the Months of *Feb.* and *Mar.* about 4 Years ſince (the Weather being reaſonably cold and not freezing) with Water, Mercury, and Spirit of Wine; wherein the following Particulars were very remarkable.

1. I took a large Bolt-head, holding about $3\frac{1}{2}$ *lib.* of Water, with a narrow Neck to make the Augment thereof more ſenſible; and having filled it with Water, and ſome few Inches up the Neck; I noted exactly to what Mark the Water came: Then I immerſed it into a Skillet of warm Water, and let it ſtand ſo long, till I concluded the warm Water had communicated its Temper to the Water included in the Bolt-head; and I found, that though the Water were warm, much beyond the Degree of the Summer's Heat, and notwithſtanding it was Winter, yet that gentle Heat had ſcarce any Effect in dilating the Water; ſo that it ſcarce appeared to have aſcended in the Neck of the Bolt-head. Then I took the Skillet, and ſet it over the Fire; when it was obſervable, that the Water, as it grew hot, did ſlowly aſcend in the Neck, eſpecially at firſt; but after it began to boil in the Skillet, the Expanſion thereof became more viſible, and it aſcended apace, till ſuch Time as it ſtopped again; the utmoſt Effort of boiling Water being able to raiſe it no higher. Then having made a Mark at the utmoſt Height whereto it had ariſen, I took it out, and had the Satisfaction to obſerve, that though it was not raiſed ſo high without a very ſtrong boiling, yet it ſubſided very ſlowly, as retaining ſome Time the Space it had acquired from the Heat, even after the Heat was paſs'd, and the Glaſs was ſo cool as to be touched without burning the Fingers. However, the next Morning I found it reduced to the firſt Mark, where it ſtood when at firſt put in, having loſt nothing ſenſible by Evaporation, during the Experiment; which I attribute to the Length of the Neck, wherein the Vapours were condenſed into Drops before they reached the Top. Then I examin'd how much Water would raiſe that in the Neck, to the Mark whereto it had been encreaſed by boiling, and found it was a 26th Part of the Bulk of the firſt Water; which, upon repeated Experiments, I found to be true; but it was obvious, that Water increaſing ſo very little, with all the Degrees of Heat the Air receives from the Sun, was a very improper Fluid to make a Thermometer withal; and beſides, any freezing Liquor is uſeleſs for this Purpoſe in theſe Northern Climates.

2. I took a ſmaller Bolt-head, with a proportional Cane or Neck, and filled it after the ſame Manner with Mercury; and having boiled it, as above, I obſerved that 125 Ounces of Mercury had increaſed the Space of 810 Grains, or a 74th Part of its Bulk when cold. But it was very remarkable, that whereas a gentle Heat had ſcarce any Effect on Water, here, on the contrary, the Mercury did ſenſibly aſcend at firſt, and had almoſt attainted its greateſt Expanſion before the Water boiled in the Skillet. And after it boiled, tho' I let it ſtand very long over the Fire, I could not diſcern that the moſt vehement boiling had any Effect on it, above what appeared when it firſt began to boil. The Mercury being taken out, as it cooled, ſubſided, and in a few Hours returned to the Mark whereat it ſtood before it was put into the Water. This Fluid being ſo ſenſible of a gentle Warmth, and withal, not ſubject to evaporate without a good Degree of Fire, might moſt properly be applied to the Conſtruction of Thermometers, were its Expanſion more conſiderable.

However, ſmall as it is, it is ſufficient to diſturb the preciſe Nicety of the Mercurial Barometers ſhewing the Counterpoiſe of the Preſſure of the Atmoſphere by a Cylinder of Mercury: For if Mercury be more expanded, and conſequently lighter in warm Weather than in cold; it will neceſſarily follow, that the ſame Weight of Atmoſphere will require a taller Cylinder in Summer, and a ſhorter in Winter to counterpoiſe it. And if the Extremity of Weather do but occaſion a 15th Part of Difference, as 'tis probable it doth, the Effect thereof, on a Barometer, will be a Tenth of an Inch above the Mean, or a Fifth in all.

3. I fill'd the ſmaller Bolt-head with Spirit of Wine; and having ſet it in the Skillet of Water over the Fire, I found that it aſcended gradually, as the Heat increaſed, but ſlower at firſt, and faſter after it was well warm. At length being arrived at a certain Degree of Heat, it would fall a boiling with great Violence, emitting Bubbles, which coming into the Neck of the Bolt-head, would lift all the incumbent Spirits till they had made their Way through. And theſe ſucceeding one another very faſt, would often raiſe the Spirit to the Top of the Neck, and ſpill it; ſo that I found I could go no further with this Liquor, than to that Degree of Heat which occaſioned this boiling, and which wanted very much of that of boiling Water, being almoſt tolerable to the Touch. It was however very remarkable, how exactly this Degree of Heat was determined by the Expanſion of the Spirit; for in the Inſtant it reached a certain Mark on the Neck, it began to emit its Bubbles: And having been taken out a little to cool and ſubſide, it would certainly and conſtantly fall a bubbling again, when upon a ſecond Immerſion, it was arrived at the foreſaid Mark. During this Experiment, it appear'd both by the Dew on the Neck, and by the Scent in the Room, that tho' the Neck were about 30 Inches long, yet the Spirit did evaporate very faſt for the Smallneſs of the Surface of the Liquor: And I have often noted the like Evaporations condenſed in Dew, within the Head of the ordinary ſeal'd Thermometers, in very hot Weather.

This Degree of Heat which made the Spirit of Wine begin to boil, being determined ſo nicely as I have ſaid, made me conclude, that this might very properly be taken for the Limit of the Scale of Heat in a Thermometer; and the Effect thereof in the Expanſion of any other Fluid being accurately noted, might be eaſily transferr'd to any ſort of Thermometer whatſoever. Only it muſt be obſerved, that the Spirit of Wine uſed to this purpoſe, be highly rectify'd or dephlegmed; for otherwiſe the differing Goodneſs of the Spirit will occaſion it to boil ſooner or later, and thereby pervert the deſigned Exactneſs. And by the way, give me Leave to hint, that the ſooner or later boiling of Spirits or ſpirituous Liquors may poſſibly be as good a Teſt of their Strength and Perfection, as their ſpecifick Gravity, or any other yet uſed.

The Spirit of Wine I made uſe of was poſſibly none of the beſt; but I obſerved, that at the Point of boiling it had increaſed a 12th Part in bulk; which great Dilatation makes it a Liquor ſufficiently adapted to our Purpoſe, were it not for the Evaporation thereof, and for the Difference in Goodneſs of the Spirit, and for that, in Length of Time it becomes as it were Effete, and loſes gradually a Part of its expanſive Power.

Hiſt. of Cold, Tit. 18. §. 8. p. 475.

4. This expanſive Power is in no Fluid comparably ſo conſpicuous as in that rare elaſtick Fluid the Air; for by ſeveral Experiments that I have made, I find that the Heat of Summer does expand the ordinary Air about a 30th Part; and that late honourable Patron of experimental Philoſophy, Mr. *Boyle*, alledges his own Trials, proving that the Force of the ſtrongeſt Cold in *England* does not contract the Air above $\frac{1}{20}$ Part. So that the ſame Air, which in extreme Cold occupies 12 Parts of Space, in very hot Summer Weather, will require 13 ſuch Spaces: which is as great an Expanſion as that of Spirit of Wine when it begins to boil: For which Reaſon, and for its being ſo very ſenſible of Warmth and Cold, and continuing to exert the ſame elaſtick Power, after never ſo long being included, in my Opinion, it is much the moſt proper Fluid for the Purpoſe of *Thermometers*.

Now the Thermometers hitherto in Uſe, are of two Sorts: the one ſhewing the different Temper of Heat and Cold, by the Expanſion of the Spirit of Wine, the other by the Air: But I cannot learn that either of them of either Sort, were ever made or adjuſted, ſo as it might be concluded, what the Degrees or Diviſions of the ſaid Inſtruments did mean; neither were they ever otherwiſe graduated, but by Standards kept by each particular Workman, without any Agreement or Reference to one another: So that whatſoever Obſervations any curious Perſon may make by his Thermometer, to ſignify the Degree of Heat in the Air, or other Things (which is of conſtant Uſe in Philoſophical Matters) cannot be underſtood, unleſs by thoſe who have by them Thermometers of the ſame Make and Adjuſtment. Much leſs has the Way been ſhewn how to make this Inſtrument without a Standard, or to make two of them agree artificially, without comparing them together.

I ſhall only add, that whereas the uſual Thermometers with Spirit of Wine, do ſome of them begin their Degrees from a Point, which is that whereat the Spirit ſtands when it is ſo cold as to freeze Oil of Anniſeeds; and others from the Point of beginning to freeze Water: I conceive theſe Points are not ſo juſtly determinable, but with a conſiderable Latitude: And that the juſt Beginning of the Scales of Heat and Cold ſhould not be from ſuch a Point as freezes any Thing, but rather from Temperature, ſuch as is in Places deep under Ground, where the Heat of the Summer, or Cold in Winter, have (by the certain Experiment of the curious Mr. *Mariotte*, in the *Grottoes* under the *Obſervatory* at *Paris*) been found to have no Manner of Effect.

Hygroſcopes; by —— n. 127. p. 650. *Fig.* 8.

XVI, 1. The *Hygroſcope* I make Uſe of, I thus contrived. I took two Pieces of Deal-board (*Poplar* would have been better) each about two Foot long, and a Foot or more in Breadth, *AB*. Theſe I got well plained and ſhotten, that their Edges might meet even together. Of theſe two, ſet Edge by Edge, I faſtned each End between two Ledges of Oak, *CC*, of 2 Inches broad, and long enough to reach athwart both Boards (but one Ledge, if it be thick enough, might be made to ſerve each End, by making hollow Furrows or Gutters in it to receive the Ends of the Boards) and ſo I fix'd both Boards in, as Pannels are ſet in Wainſcot. This done, ſuppoſing $\frac{1}{4}$ of an Inch to be the utmoſt Diſtance that theſe two Boards would ſhrink aſunder in drieſt Weather (for it matter'd not much, though it ſhould be ſomewhat more or leſs) I took a thin piece of Braſs, *D*, of two or three Inches long and $\frac{1}{4}$ Inch broad; and upon one edge, towards the end, I meaſured $\frac{1}{4}$ of an Inch (which was the utmoſt Diſtance I ſuppoſed the two Boards would gape aſunder (which Space *dd*, I divided into five equal Parts, and with a ſmall File made them into ſo many fine Teeth, like thoſe of a Watch Wheel; this piece of Braſs I placed flat, acroſs the Juncture of the two Boards, nailing its one end, by means of two ſmall Holes, *bb*, to the Board *A* only, and leaving the other End, which s the toothed one, free, and reaching to a competent Diſtance over the Board *B*, to which it had no Coherence; next I made a Pinion (conſiſting of as many Teeth as the Braſs had) *e*, upon the end of a Piece of thick Iron Wire; this Axle, *F*, with its Pinion *e*, I ſo faſtened to the other Board *B*, by means of the Brachiolum *E*, and ſo adapted to the Teeth of the Braſs-plate, that when the Boards do ſhrink aſunder, the Braſs being drawn a little away, muſt needs turn this Axle (by means of its toothed Pinion) more or leſs; and ſo if ever it happens, that the Boards gape but a Quarter of an Inch aſunder, this Axle, will have made one intire Revolution: Wherefore I put a long Index *G G*, upon the Extremity of this Axle, and made a Circle round it with the uſual Graduations, number'd from what Point I pleaſed; and the Motion of the Index back or forward, ſhews me the Degrees of the Drought or Moiſture of the Air. Now this Axle may be made to come through a round Plate of Wood or Metal that hides the Contrivance, all but the Hand and Figure, as in a Clock or Watch. 'Tis to be noted, moreover, that the Boards muſt be faſtned to the Ledges, only at the outer Edges, as at *aaaa*, that they may have the more liberty of ſwelling and ſhrinking aſunder. Tho' the *Hygroſcope* which I make uſe of be none of the beſt Workmanſhip, nor exactly made after the Deſcription I have here given you (the Boards having not liberty of gaping above $\frac{2}{10}$ of an Inch) yet I have oftentimes the Pleaſure of ſeeing the Index turn 10 or 20 Degrees in an Hour or two, and when the Air is changed, will return as ſwiftly, by the ſhrinking and ſwelling of the Boards.

By Mr. Coniers, n. 129. *p.* 715. *Fig.* 9.

2. *A A A A*, is a Frame of Wood for two Pannels of Deal to play looſe in at top and bottom, to which at the two ends they are faſtned. *B B*, the two Pannels of ſlit Deal, three foot Deep and three foot Broad apiece, with a diſtance left in the middle for the Scope of the Motion. *C*, the Hand placed or faſtned by the Axle-tree to the Plate, and alſo with Nail-holes which are to faſten it to the middle of the Pannel within half an Inch of the Scope for Motion; at the lower or ſhorter End of which Axle-tree there is, by a Wire like an *S*, faſtned a ſmall Silver Chain within a Straw's breadth of the Axle-tree; which Chain is to be carried and placed croſs the Diſtance between the two Pannels, and faſtned to the Pannel oppoſite by a braſs Nooſe, through which it is to ſlip, ſo as that it may be taken up or let down at pleaſure. *D*, the Roller with a Weight annexed, which by a String is faſtned to the loweſt End of the Hand *C*; ſo that as the Relax gives way, the Weight will adjuſt the Motion of the Hand to the Index *E*. *E*, the Index of Paper,

paſted upon the oppoſite Pannel to the Hand, and ſo as it is in this Figure, placed near the Top, for the better Advantage of the Hand's Motion; and this Index being but a Quarter of a Circle, is divided into Inches more or fewer, according to the Scope which the Pannels Hand requires for their Motion; but when the Relax ſhall require more room for the Hand, then the Chain is to be taken up one Link more, and ſo you will be ready for more play upwards and downwards; which taking up, may yet be again repeated when there is occaſion, or the Time of Year requires it.

Now, if the Chain be placed near the Axle-tree, the Motion will be the nicer and larger; if farther off, then it will be leſs: For Example, the Motion of 2 more than that of 3, and 3 than that of 4, *&c.* as you may perceive by the Figures 2, 3, 4, 5, 6; which are placed in this Figure by the lower end of the Hand near below the Axle-tree thereof.

From this Contrivance it was, That I have for this 5 or 6 Years paſt made theſe following Obſervations.

1. That theſe Pannels of Deal-wood will move by ſhrinking moſt in Summer, and ſwelling moſt in Winter Seaſons; but will vary from this, according to the Change, to the then more or leſs Heat or Cold, Moiſture or Drought, that the Temper or Seaſon of the Year, ſuch as Spring and Fall, do produce; it being then more apt to ſwell or ſhrink on the ſudden, but not attaining then to the higheſt ſhrinking or ſwelling, as in Summer and Winter it doth.

2. That for the moſt part, eſpecially in the Spring and Summer Time, this Motion happens only in the Day Time; for then generally all Night it reſts, and moves very ſeldom.

3. That one Kind or Manner of this Motion happens in dry, fair Weather; but ſometimes in the forepart of the Forenoon, and ſometimes not until the latter part of the Forenoon, and then at that Time it relaxes or ſwells the Deal for about two or three Hours; more, ſeldom; leſs, often; and then all the Afternoon after ſhrinks; nay, ſometimes even when a ſmall Rain hath newly fallen, or is then falling; and this not ſo often, but more ſeldom in Winter, or cold moiſt Weather.

4. This Shrinking is gradual very often, or for the moſt part a little after a moiſt Time (*viz.*) the firſt Day after Moiſture it ſhrinks a little; the ſecond Day, more, and ſo yet more, according to the then Time of the Year; and as it is then inclined to Moiſture or Drought, and Alteration of the Wind, and the then Heat or Cold.

5. The Winds being in the North, North-eaſt, and Eaſt, Winter and Summer, for the moſt part at that Time the Deal ſhrinks, in the Night alſo as well as in the Day, but not ſo much; which is a ſign of drying Weather, and ſometimes of Froſt or Cold in Winter, Heat or Scorching in Summer, in a clear Day. But on the contrary, the South Winds blowing, or the Weſt and South-weſt, the Deal then always relaxes that Day, or at leaſt is at a Stay, provided this happen in the Day Time; for then if in the Night, not ſo much; and ſo this will do ſome conſiderable Time before Rain.

6. By a conſtant Obſervation of this Experiment of the Deals Motion and Reſt, you may be able to know or gueſs at the Wind's Situation without a Weather-cock, provided you have by you a common and a ſeal'd Thermometer.

7. Alſo you may know the Time of the Year: For in the Spring it moves quicker, and more than in Winter; in Summer it is more ſhrunk than in the Spring; in Autumn leſs in Motion than in the Summer.

I ſhall only add, that to find whether the Moiſture was rarified out of the ſmall Cylinder-like Ends of the Wood only, or out of the Sides alſo, I took two Pieces of a ſeaſon'd Deal; the Ends of the one Piece I cloſed up with Diachylon Plaiſter, but the Sides of this Deal I did not ſo cloſe up, but left theſe Sides with the other Piece without Diachylon. Both being expoſed to the open Air, they were found the next Day both of them alike to have increaſed in proportion of Weight; which ſeems to prove that the Sides alſo do take in and let out Moiſture.

In a ſecond Contrivance, *AAAA*, is the Frame of Wood for the Pannels *Fig.* 10. of *Deal* to play looſe in, at the Top and Bottom. *BBBB*, the Croſſes of Deal or Iron faſtened to the Frame on each ſide; to which is annexed the Circular Index divided into 12, in the Center of which the Axle-tree *b*, for the Hands, is placed. *CC*, the two Pannels of ſlit Deal, 3 Foot deep, and 3 Foot broad apiece, faſtned at each End of the Frame, with a Diſtance left in the middle for the Scope of the Motion.

The inward Work is thus contrived. *AA*, the two Hands. *BB*, the two *Fig.* 11. braſs Pullies or Rollers, the one bigger, the other leſs; to the bigger a flat leaden Weight is faſtned with a Cat-gut String; to the ſmaller is faſtned a ſmall ſilver Chain, which is by the Nooſe or Loop of the Braſs *C*, to be faſtned to the Pannel under the middle of the Croſs, near the Gap or Scope for the Motion; and in that Nooſe the Chain to have a faſtning to be taken up or let down at pleaſure. *D*, the Roller or Pulley to be placed on the other Pannel oppoſite to the Nooſe, and near the Gap or Scope, betwixt the two Pannels; over which Roller the ſmall Chain, upon its return to the Axle-tree, is to be placed. *E*, the Axle-tree, upon which the two Rollers or Pullies, *Bb*, are to be faſtned, and the two Hands, *AA*, for the Index. *F*, the Weight annexed to the biggeſt Roller or Pulley *B*; and the String or Cat-gut to be moved, is to have the contrary Poſture for Motion to the ſmall Roller or Pulley upon which the ſilver Chain is faſtned: So that as the Shrinking of the Pannel moves the Axle-tree one way, the Relaxing may give to the moving the Hands or Axle-tree the other way by the Power of the Weights drawing; which contrary Poſtures will give the niceſt Account of this Motion.

The Circumference of the ſmalleſt Pulley or Roller, *b*, is to be no bigger than juſt ſo much Scope or Diſtance as the two Pannels make by the Extremity of their utmoſt Swelling or Shrinking; and ſo one full Revolution of the Hand upon the Index may anſwer the fulleſt Shrinking and Swelling in the Year, and the Diſtance between the two Rollers or Pullies fix'd upon the Axle-tree, muſt be the Thickneſs of your Pannels; ſo that the Weight is to play or move on the one ſide of the Pannel, and the Chain on the other, without Diſturbance, or rubbing againſt the Sides of the Pannel or the Croſs, between which, out of ſight, in the Middle, they are to be placed.

This way was ſo contrived 1675. ſome Years after the former; and ſo with Chain and Pullies to avoid the ſhaking that would happen by applying the Work of Pinion and Teeth to move the Hands; which was then alſo propounded to Mr. *Tompion* the Watch-maker, but by him rejected; though I think that way may be uſed alſo, with a Weight added to regulate the Motion.

The Deal Board ſhould be of the fineſt ſtreighteſt grain'd, *Drum Deal*, laid a drying in your Houſe two or three Years.

By Mr. Molyneux, n. 172. p. 1032. *Fig.* 12. 3. *AB*, is a Whipcord about four Foot long, tied faſt to the End of the Hook, *A*. At the End of this Whipcord there hangs the Weight, *C*, about a Pound, or ſomething more; this Weight is ſo fitted at the End as to receive and carry the Index, *D*. Under theſe there is placed a graduated Circle on the Board, *EF*, fix'd by a Bragget againſt the Wall.

All Things being thus adapted, the Moiſture of the Air twiſts the Rope, and gives a Motion to the Index over the Diviſions in the graduated Circle; and again, as the Air grows more dry, the Cord untwiſts and brings back the Index by a contrary Motion. The Reaſon of this is plain, for the little Particles of the Moiſture inſinuating and ſoaking into the Cord are like ſo many Wedges which muſt needs ſhorten the Rope, as a Bladder is ſhortned by being blown up, and will lift a great Weight; but the eaſieſt Way for the Rope, *AB*, to ſhorten and lift up the Weight, *C*, is to do it by way of a Screw, for itſelf is a Screw, the Stands thereof being twiſted (and each particular Thread in it (Screw-wiſe, and conſequently muſt give a circular Motion to the Index.

To make an Experiment of this, I wetted a Cord and hung it up with the Weight at the end of it, and I perceived as it dried it untwiſted, and that too very quick, ſo as to be perceived by the Eye; after the Cord had ſo far untwiſted, as I thought it had come to that Degree of Drineſs, that the preſent Conſtitution of the Air would permit, I took a Baſon of warm Water, that ſent out a Steam and Fume, and placed it under the Cord; immediately the Cord began again to twiſt very quick, and ſo continued till the Water ceaſed fuming, or was removed, and then immediately it began to return its Twiſts. I then tried to breathe upon it gently with my Breath, and found, according to my Expectation, that 8 or 10 Breathings would twiſt it 5 Degrees of a Circle. I then permitted it to the Air only, and I find it to obey the Alterations thereof moſt nicely; there falls not the leaſt Shower, at which it does not preſently twiſt; and when by riſing Clouds a fair Day becomes overſhadowed, the Cord is immediately ſenſible thereof, and again as ſenſible of their Vaniſhing and Alteration to fair Sun-ſhine. So that I repute it to be the niceſt *Hygrometer* that has ever yet been uſed, and I am ſure is as cheap and plain as any.

One of the grand Defects of moſt (indeed I think of all) *Hygrometers* hitherto invented, is, that they grow weak with Age, and do not ſo nicely obey the Alterations of the Air, when long kept, as when firſt made; but whether our preſent Invention be ſubject to the ſame Fault, I leave to Time to determine.

The Alterations alſo of the Air may give this kind of *Hygroſcopes* more than one Turn; now this being inconvenient, and the Dublication of the Turn hard to be regiſtred, as Mr. *Hook* propoſes in his *Micrography*, concerning the Beard of a wild Oat; I have thought of a Way for remedying this, for it being in our Power to increaſe the Diameter of our graduated Circle as large as we pleaſe, what need have we of more than one Turn, from the greateſt Degree of Moiſture to the greateſt Degree of Drought? Now ſuppoſe I find this *Hygroſcope* to have two compleat Revolutions (this is to be founded by Obſervation throughout a whole Year) I ſay then the way of rectifying it is thus: The Index *D* has two compleat Turns, the Point *A*, as being fix'd, has no Turn or Motion, therefore the middle Point, *G*, has but one Turn; and conſequently if I hang it up at the Point *G*, or no longer than *G D*, half the former length, the Index *D* will have but one Turn. What is here ſaid of two Turns, and the middle Point *G*, may be accommodated to any other Number of Turns and Parts, and Points in the Rope.

If a Candle, or heated Iron, be apply'd nigh the Rope, it makes it twiſt very quick, contrary to Mr. *Hook*'s Oat-Beard.

We may in this Experiment perceive ſomething that may help us in the Conſideration of the Strength and Motion of the Muſcles of Animals; for take a Cord able to ſuſtain an hundred Pound weight, by the weak Fume or Steam of warm Water this Weight ſhall be lifted up; for if this Steam turn the Weight (as moſt certainly it will do, if the Rope be of any moderate Length) the Weight is as certainly lifted up thereby as by a Screw, as is evident to any one that conſiders it. If therefore ſuch mighty Performances can be produced by the Application of ſuch mean Agents, as we all know and are converſant with, what ſhall we think is too great for thoſe Parts which God has contrived and framed in the Bodies of Animals?

4. It is obſerved, that when *Oil* of *Vitriol* is ſatiated in the moiſteſt Weather, it afterwards retains or loſes its acquired Weight as the Air proves more or leſs moiſt. *By Mr.* Will. Gould, n. 156. p. 504. Thus one Grain, after its full Encreaſe, often vary'd its *Equilibrium* ſo ſenſibly, that the Tongue of the Ballance of 1½ Inch long deſcribed an Arch of Variation to ⅓ of an Inch Compaſs (which Arch would have been 2⅔ Inches, had the Tongue been but one Foot in length) even with that little Quantity of Liquor; *Vid. inf.* Cap. III. ſo that if more Liquor expanded under a large Surface be uſed, the minuteſt Alteration of Weather muſt needs very much more affect it, and a bare Pair of Scales will afford an *Hygroſcope* as nice, perhaps, as any yet known.

This Balance may be contrived two Ways, either ſuch whoſe Pin ſhould be *Fig.* 13. in the middle of the Beam, with a very ſlender tapering Tongue, of a Foot, or one Foot and a half long, pointing to the Diviſions on a broad arched Plate, fix'd above in the Handle; or elſe the Scale with the Liquor may be hung to *Fig.* 14 a Point of the Beam very near the Pin, and the other Extream made ſo long as to mark a large Arch on a Board plac'd conveniently for that Purpoſe. The Scale in either may be a Concave Glaſs of four or five Inches diameter. Laſtly, On the Diviſion of the Arches ſhould be inſcrib'd the different Temperature of the Air ſhewn by the Liquor.

I have Reaſon to think that *Oil* of *Sulphur per Campanum*, as alſo *Oil* of *Tartar per Deliquium*, and the Liquor of *fix'd Nitre*, &c. may ſucceed as well.

Another; *by Mr.* Will. Gould, *ib.* p. 509. *Fig.* 15.

5. Another *Hygroſcope* may be made of a Viol-ſtring running upon Pullies, and ſuſpending a Bullet fix'd to the ſhorter End of an Index, whoſe other Extremity is ſo long as to deſcribe a long Arch, by the falling and riſing of the Bullet upon the ſtretching and ſhrinking of the String; which would be more nice, were the Index faſtned to the Center of the laſt Pully.

To obſerve the Srength of Winds; *by* --- n. 24. p. 444. *Fig.* 16.

XVII. Expoſe the Inſtrument, *A B C D*, to the Wind, ſo as the flat Side *C D*, may be right againſt it; the Number of Degrees upon the Limb, *A B*, to which the Wind blows up, or raiſes that flat Side, ſhews the Force or Strength of the Wind, in Proportion to the Reſiſtance of the flat Side of the Inſtrument.

Remarks concerning the gradual Alteration of the Temperature of the Air in America, *and in* Ireland; *by* --- n. 127. p. 648.

XVIII. That in *America* (at leaſt as far as the *Engliſh* Plantations are extended) there is an extraordinary Alteration, as to Temperature, ſince the *Europeans* began to plant there firſt, is the joint Aſſertion of them all. This Change of Temperature is, and not without ſome Reaſon, generally attributed to the cutting down of vaſt Woods, together with the clearing and cultivating of the Country. But that *Ireland* ſhould alſo conſiderably alter, without any ſuch manifeſt Cauſe, doth very much invalidate that Reaſon. For if it be true, as ſome compute, that this Kingdom was better inhabited and huſbanded before the late bloody War, than at preſent, it ſhould, according to the Reaſons alledg'd for the Change of Temperature in *America*, be rather grown more intemperate, *viz.* for want of Cultivation: But the contrary is obſervable here, and every one almoſt begins to take Notice, that this Country becomes every Year more and more temperate. Now whether there were more Inhabitants in *Ireland* before the late War than at preſent, I ſhall not here inſiſt upon, neither do I think it an eaſy Matter to determine; yet ſure I am, that there has been no ſuch Increaſe of People here within theſe ſixteen or twenty Years, nor ſuch Improvements as to be accountable for the great Change of Temperature that is of late obſerved. Within leſs than the Time newly mentioned, 'twas not unuſual to have Froſt and deep Snows of a Fortnight and three Weeks Continuance; and that twice or thrice, ſometimes oftner in a Winter; nay, we have had great Rivers and Lakes frozen all over; whereas of late, eſpecially theſe two or three Years laſt paſt, we have had ſcarce any Froſt or Snow at all. Neither can I impute this extraordinary Alteration to any fortuitous Concourſe of ordinary Circumſtances, requiſite to the Production of fair Weather; becauſe it is manifeſt, that it hath proceeded gradually, every Year becoming more temperate than the Year preceding. And I obſerved particularly, that all the Winter, $167\frac{4}{5}$, was very mild, and warmer than could be well expected from ſuch a Seaſon, and but very little Rain; having in the whole Month of *February* not rained above twice or thrice (at leaſt in that Part of the Country where I then was:) inſomuch that many took upon them to predict, that ſuch unſeaſonable Weather would certainly be the Cauſe of ſome Dearth or Peſtilence the enſuing Summer, or Autumn; but their Predictions proved as falſe as the following Harveſt was extraordinary both for Health and Plenty.

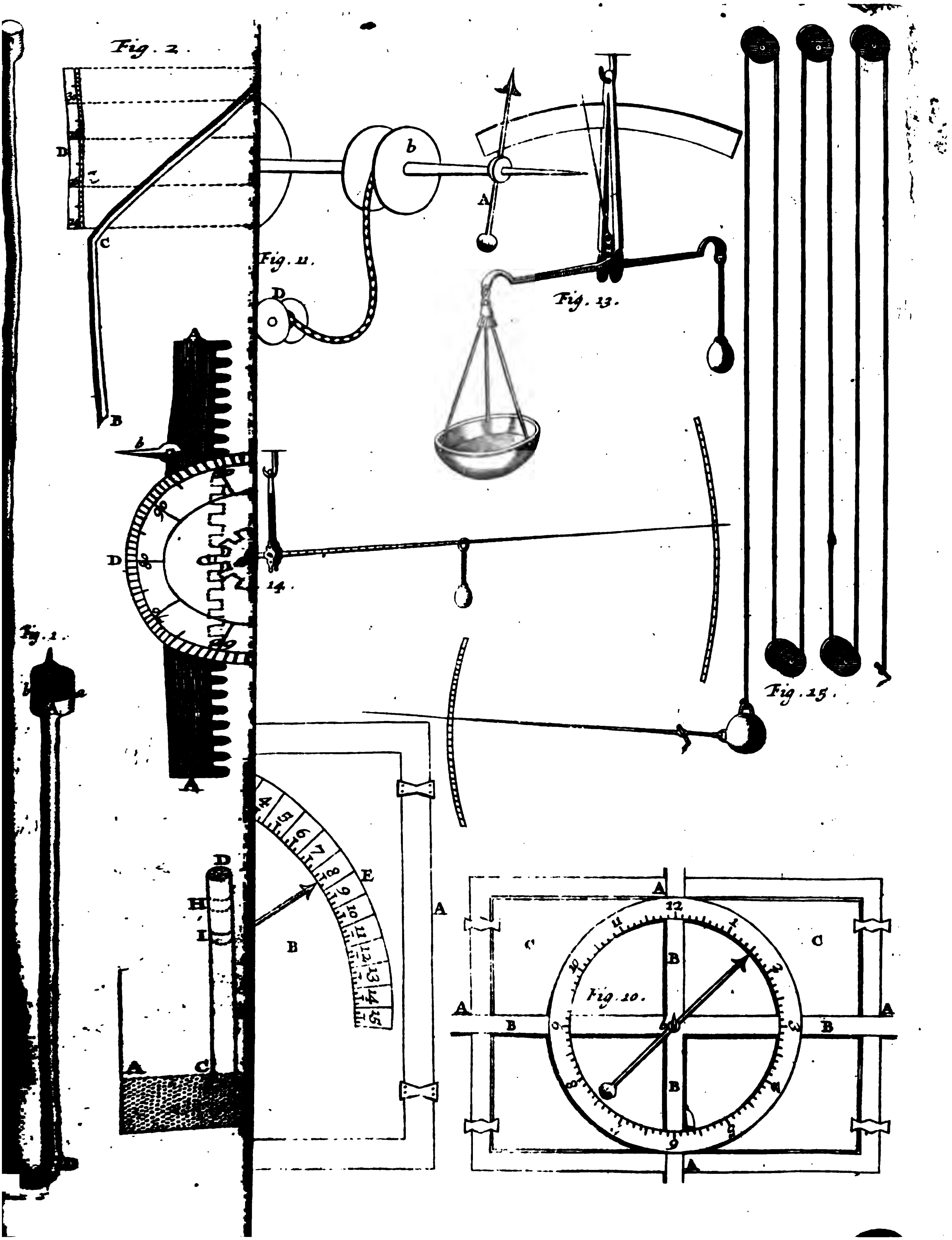
Fig. 2.
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C
B
Fig. 11.
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Fig. 13.
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Fig. 1.
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Fig. 10.
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Fig. 15.

Obſervations of the Weather in Ireland, 1675. *ib.* p. 649.

This Winter, $167\frac{5}{6}$, now newly ended, I have kept an exact Account of Wind and Weather, being well provided with a *Barometer*, ſealed *Thermometers*, *Hygroſcopes*, &c. To tranſcribe my Journal here would be too tedious; let it ſuffice therefore to tell you, that it hath been a very fair and warm, or rather no Winter at all; that we have not had above five or ſix froſty Mornings this Winter, and none that laſted longer than till Noon; that we had Snow but thrice; the firſt before *Chriſtmas*, the ſecond upon the eleventh, and the third upon the ſeventeenth of *January*: This laſt, which was the longeſt Snow we had this Winter, continued not forty eight Hours, but thawed. All this Winter we never had two Days of Rain together, nor above two or three that could be well called Rainy Days. *March* 14, we had a Shower of Rain and Hail together; the Wind being South-weſt and calm. The Mercury in my *Barometer* (which is very ſlender, but carefully fill'd, and conveniently placed) is for the moſt Part about $29\frac{4}{10}$ Inches high, above the Surface of the ſtagnant Quick-ſilver; but yet doth very ſenſibly and frequently vary its Height, according to the Difference of the Atmoſphere's Gravity. *Jan.* 17, (which was the Day it laſt ſnowed here) the Mercury was ſubſided to $28\frac{9}{10}$ Inches. The next Day it was $28\frac{6}{10}$, being towards Night ſomewhat bluſtering, and the Snow thawed. *Jan.* 19, being fair, but very foggy, the Mercury was at $28\frac{1}{2}$, which is the loweſt Station it was ever at yet with me; the Wind was Weſterly and calm. The next Day it was up again to 29, and afterwards higher. *Feb.* 15, in the Morning, being cloudy, the Wind Weſterly and bluſtering, the Mercury was at $29\frac{8}{10}$; and about eleven that Night, being fair, clear and calm, it was riſen to $30\frac{2}{10}$ Inches. The next Day being ſtill fair, and calm, it was at $30\frac{3}{10}$ Inches; which is the utmoſt Height I have yet ſeen it at. Next Day it fell a little beneath 30, and kept, as before, for the moſt Part about $29\frac{3}{10}$ or $\frac{4}{10}$ to this preſent; only on the eleventh of *March* it was at 30 again. Though it be obſerved, that froſty and ſnowy Winters make early Springs, and for as little as we have had of either this Winter, yet there hath not, within the Memory of any now living happened a forwarder Spring in *Ireland*; ſince this Place could produce ſome Store of ripe *Cherries* in the midſt of *April*. The Wind keeps, for the moſt Part, here between the North-weſt and the South, ſeldom at Eaſt, and yet ſeldomer at North or North-eaſt; inſomuch that many here dont ſcruple to affirm, that for at leaſt $\frac{3}{4}$ of the Year, the Wind is Weſterly; and we have ſometimes known Paſſengers wait at *Cheſter* and *Holy-Head* no leſs than three Months for a fair Wind to come hither.

To meaſure the Quantity of falling Rain; by Mr. Townley, n. 208. p. 51.

XIX. I fixed a round Tunnel of twelve Inches Diameter to a Leaden Pipe, which could admit of no Water, but what came through the Tunnel, by reaſon of a Part ſolder'd to the Tunnel itſelf, which went over the Pipe, and ſerved alſo to fix it to it, as well as to keep out any wet that in ſtormy Weather might beat againſt the under Part of the Tunnel; which was ſo placed, that there was no building near it that would give Occaſion to ſuſpect that it did not receive its due Proportion of Rain that fell through the Pipe, ſome nine Yards perpendicularly, and then was bent into a Window near my Chamber, under which convenient Veſſels were placed to receive what fell into the Tunnel; which I meaſured by a Cylindrical Glaſs, at, a certain Mark containing juſt a Pound or twelve Ounces *Troy*, and had Marks for ſmaller Parts alſo. By the Help of this Cylindrical Glaſs I thus kept my Account of what Rain fell, and generally twice or thrice a Day; when I took ſeveral other Obſervations, both of the *Thermometer*, *Barometer*, Winds, *&c.* What Rain I found in the Receivers, if not more than made what was left in the Cylindrical Glaſs a full Pound, I again left in it; but if there was more than that Quantity, I filled it juſt to the Pound Mark, which I threw away, and did the like with the remaining Water as often as it would allow, ſtill keeping an Account chiefly of the Pounds thrown away, and noting alſo the Parts of a Pound remaining in the Glaſs; by the Help of which latter, and the Parts remaining at any Time before, but numbering the Pounds and ſubtracting the Parts at the End (for Example, of one Month) from the Pounds thrown away, and the Parts remaining at the End of another, I find the Quantity of Rain fall'n betwixt theſe two Times, and that ſo as to aſſure me, that I erred no more in the Quantity of Rain of another Year, than by the Miſtake in the Differences of the Parts of a Pound in the firſt and laſt Obſervation; whereas ſhould I ſtill write down the Rain that falls between two Obſervations, I might be ſubject to make as great a Miſtake in every one of them, and conſequently be much more uncertain of the Quantity of Rain fall'n in many of thoſe added together: Beſides, this Addition is longer in performing and giving the Quantity ſought, than the Method I make uſe of. I have added theſe Particulars to ſhew you how little Trouble there is in this Taſk.

Obſervations of the Rain, falling Monthly for 15 Years; by Mr. Townley, *ib.* p. 53.

	1677	78	79	80	81	82	83	84	85	86	*Sum.*
Jan.	472	371	43	512	53	986	238	32	110	472	3289
Feb.	270	371	161	492	363	135	245	483	42	20	2582
March	245	250	202	413	235	237	305	87	185	572	2731
April	325	170	92	222	57	308	402	370	380	305	2631
May	313	581	105	188	69	315	353	97	201	437	2659
June	516	257	298	342	397	517	468	192	410	473	3870
July	351	339	350	302	292	482	412	313	497	188	3526
Auguſt	485	145	835	502	425	385	582	338	398	870	4965
Septemb.	223	527	553	146	607	293	152	199	163	572	3435
October	333	644	616	570	170	427	330	425	325	293	4133
Novem.	432	555	127	479	235	525	192	579	522	709	4355
Decemb.	400	57	439	269	423	456	37	299	548	132	3051
Sum.	4365	4267	3821	4428	3326	5066	3716	3414	3781	5043	41227

	1689	90	91	92	93	*Sum.*
Jan.	333	707	197	54	218	1509
Feb.	393	171	112	168	78	922
March	875	145	476	347	298	2136
April	468	78	386	498	539	1969
May	182	244	300	330	93	1149
June	302	179	412	416	181	1490
July	120	218	285	448	112	1183
Auguſt	222	402	193	198	668	1683
Septem.	442	403	215	605	641	2306
October	740	765	165	273	514	2457
Novem.	415	717	230	148	627	2137
Decem.	368	262	169	892	261	1952
Sum.	4860	4291	3140	4372	4230	20893

All I have yet learnt from theſe Obſervations, as to the main Point, is, that here we have almoſt juſt twice the Quantity of Rain that falls at *Paris:* This County (of *Lancaſter*) and particularly that Part of it (about *Townley*) where I live, being generally eſteemed to have much more Rain than other Parts, and in a greater Proportion than I thought reaſonable to be allowed; however it be, yet by what I have ſent you, 'twould be unjuſt, without farther Obſervations of the like Nature in other Parts, that all *England* ſhould be eſteemed to abound as much in Rain as theſe Parts do, where, by reaſon of the very high Grounds in *Yorkſhire*, and the Eaſtern Parts of *Lancaſhire*, the Clouds driven hither by the *S.* and *S. W.* the general Winds in this Part of the World, are oftner ſtopp'd and broken, and fall upon us, than ſuch as come by an *E.* or *S. E.* Wind, which, broken by the Hills, are generally ſpent there, and then little affect us; and this is the Reaſon that *Lancaſhire* has often conſiderably more Rain than *Yorkſhire.*

In the Table I have ſent you the Pounds and Parts are doubled, and theſe I have rather ſent you than thoſe of the whole Pounds; ſince the ſame gives both the Quantity of half Pounds, and the Height in Inches, according to the general Way of eſtimating the Quantity of Rain; only with this Difference, that for the half Pounds, only the laſt Figure is a Decimal Fraction, and the other the Number of the half Pounds; and for the Height, the two laſt Figures denote the decimal Fraction of an Inch, and the Remainder the Height in Inches, ſo near the Truth, that they only fall ſhort of it 1 Inch in 200; which Defect is eaſily ſupplied. To this I need only add, that the Numbers on the Right-hand are the Sums of all thoſe in the ſame Line that is in the firſt Part of ſeveral Numbers for ten Years; ſo that the laſt of them ſhews the Sum both of the half Pounds that have fallen during that Space of Time, and the Height the Water would have been raiſed in that Time alſo. To this I ſhall only add one Example: The Sum of all the Rain in the ten firſt Years is 41227; and therefore according to what hath been ſaid, 4122,7 is the Number of Half Pounds that fell in the Compaſs of the Tunnel during thoſe ten Years; and 412,27 the Height it would have raiſed the Water during that Time. But if you deſire to be more critical, if you add 206, its two hundredth Part, you will have 414,33 for the true Height, and 41,433 for the mean Height, by thoſe ten Years Obſervations; and 412,17 for the mean Quantity of half Pounds. By the ſame Method you will have the Means for the other five, *viz.* of Height 41,78, and 417,8 for the mean Number of half Pounds, which Means do ſtrangely agree, and both conſidered, do give for the Mean by all the fifteen Years 41,516 Inches in Height, which is about ½ of an Inch more than double to that raiſed by the Water at *Paris*, which is ſet down in the *Memoirs for the Ingenious*, for *February* laſt, and is ſtated about 19½ *French* Inches, which make 21 *Engliſh*.

My way of Gauging by Weight is grounded upon 22,7368 Cubical Inches of Rain-water, being equal in Weight to one Pound, or 12 Ounces *Troy*; ſo that dividing any Superficies in Inches of a Veſſel, for receiving the Rain-water, by the before-mentioned Number, it will give you the Pounds and Parts that will raiſe the Water upon that Superficies, with upright Sides, juſt an Inch: And thus I found that 4,974 Pounds would fill a Cylinder equal at the Bottom to my Tunnel and one Inch high, which you ſee is very near 5 Pound, which you will alſo find will only raiſe the Cylinder higher by $\frac{1}{200}$ Part.

A Hiſtory of the Weather at Oxford, 1684; *by Dr.* Plot. n. 269, p. 930. *Fig.* 17.

XX. I here give you the Obſervations of a full Year, made by Order of the *Philoſophical Society* at *Oxford*, not only of the Riſe and Fall of the Quickſilver (mark'd by the wandring prick'd Line, after Dr. *Liſter*'s Method) and the Weather; but alſo how the Wind ſtood each Day. If the ſame Obſervations were made in many foreign and remote Parts at the ſame Time, we ſhould be enabled with ſome Grounds to examine, not only the Coaſtings, Breadth and Bounds of the Winds themſelves, but of the Weather they bring with them; and probably in Time thereby learn to be forewarned certainly of divers Emergencies (ſuch as Heats, Colds, Dearths, Plagues, and other Epidemical Diſtempers) which are now unaccountable to us; and by their Cauſes be inſtructed for Prevention, or Remedies. Thence too in Time we may hope to be informed how far the Poſitions of the Planets, in relation to one another, and to the fixed Stars, are concerned in the Alterations of the Weather, and in bringing and preventing Diſeaſes, or other Calamities; for by this means it is, doubtleſs, that the Learned Dr. *Good* of *London*, has arrived to that Pitch of Knowledge he already has in predicting Weather. This, no queſtion was the Opinion of the Induſtrious *Walter Merle*, Fellow of *Merton College*, who thus obſerved the Weather here at *Oxford* every Day of the Month ſeven Years together, *viz.* from *January* 1337 to *January* 1344; the MS. Copy of which Obſervations are yet remaining in the *Bodleian* Library. And doubtleſs it was ſome ſuch Conſideration as this, that moved *Eraſmus Bartholin* to make Obſervations of the Weather every Day through the whole Year, 1671, which are printed *inter Acta Medica Tho. Bartholini.*

Weather,

D.	*Weather*, Jan. 168¾.
1	Hard Froſt, and fair.
2	Froſty, but yielding a little towards Night.
3	Rimy Froſt.
4	Hard Froſt and fair.
5	Hard Froſt and fair.
6	Hard Froſt and fair.
7	Hard Froſt, but a little yielding at Night.
8	Rimy Froſt Morning, fair all Day, windy Night.
9	Froſt, but Snow at Night.
10	Cold raw Weather toward Noon, Rain toward Night.
11	Moiſt, thawing Weather.
12	Cloſe, thawing Weather.
13	Moiſt, cloſe Weather, a ſmall Froſt at Night.
14	Cloſe, froſty Weather.
15	Cloſe, froſty Weather.
16	Cloſe, froſty Weather, at Night windy.
17	Froſt, at Night Snow.
18	Snow and Wind.
19	Cloſe, ſharp Weather.
20	Cloſe, *ut ſupra*, but a little yielding at Night.
21	Mild Froſt and fair.
22	Hard Froſt, Snow at Night a little.
23	Hard Froſt.
24	Hard Froſt and fair.
25	Hard Froſt and Snow.
26	Froſt, a little Snow.
27	Froſt, a little Thaw about Noon.
28	Froſt and fair.
29	Froſt, a ſmall Thaw all the Afternoon.
30	Hard Froſt and fair.
31	Froſt and fair.

D.	*Winds.*	*Weather*, Feb. 168¾.
1	*N. E.*	Froſt and fair.
2	*N. E.*	Froſt, a little Thaw at Night.
3	Due *E.*	Froſt and fair.
4	Due *S.*	Cloſe Weather, and a little Thaw and Snow at Night.
5	*S. W.*	Thawing Weather, Wind and Rain at Night.
6	Due *W.*	Fair, clear Weather.
7	Due *W.*	Cloſe, thawing, rainy Weather.
8	*N. by W.*	Cloſe Weather.
9	Due *S.*	Fair in the Morn. Rain and Snow at Night.
10	Due *S.*	Cloſe, wet Weather.
11	Due *S.*	Fair Morning, wet at Night, and windy.
12	*S. S. W.*	Cloſe Morning, fair at Night.
13	*N. by W.*	Cloſe Morn. fair at Night.
14	*W. and N.*	Rainy Morn. fair at Night.
15	*N. W.*	Fair Weather.
16	Due *S.*	Rainy Morning, cloſe at Night.
17	*S. W.*	Cloſe, moiſt Weather.
18	*S. W.*	Rainy and Wind.
19	Due *W.*	Moiſt Morning, fair Afternoon.
20	*W. S. W.*	Open, fair Weather.
21	*S. W.*	Cloſe Weather, windy.
22	*W. S. W.*	Cloſe, rainy Weather.
23	Due *W.*	Wet Morn. fair Afternoon.
24	*W. by S.*	Fair Morning, cloſe Evening.
25	*S. W.*	Fair Morning, cloſe Evening.
26	*S. W.*	Wet Morning, cloſe Evening.
27	*S. E.*	Wet Morn. fair Evening.
28	*N. E.*	Cloſe, froſty Weather.
29	*E. by S.*	Froſty, clear Weather.

Wind.

D.	*Wind.*	*Weather*, March 168$\frac{3}{4}$.	*D.*	*Wind.*	*Weather*, April 1684.
1	*S. E.*	Cloſe, froſty, cold Weather.	1	*N. & W.*	Fair, ſun-ſhine Weather.
2	*N. E.*	Cloſe, cold Weather.	2	*W. by N.*	Rain in the Morning, fair Evening.
3	*N. by W.*	Cloſe, froſty Weather.	3	*S. by W.*	Fair Morning, Wind and Rain at Night.
4	*N. by W.*	Cloſe, cold Weather.	4	*S. by W.*	Cloſe, moiſt Weather.
5	Due *N.*	Cloſe Morning, Snowy Evening.	5	*S. W.*	Rainy Weather.
6	*N. E.*	Cloſe, cold Weather.	6	Due *W.*	Fair Morning, wet at Night.
7	*N. N. E.*	Froſt, fair and windy.	7	Due *W.*	Fair Weather.
8	*N. N. E.*	Froſt, cloſe and windy.	8	*S. W.*	Cloſe Weather.
9	*E. by N.*	Froſt and high Winds.	9	*N. W. & N.*	Cloſe Weather, but fair.
10	*E. N. E.*	Cloſe, froſty, cold Weather.	10	*N. E.*	Cloſe, fair Weather.
11	*N. by W.*	Froſt and fair, cloſe at Night.	11	Due *E.*	Rain and Wind moderate.
12	Due *N.*	Froſty, ſnowy, windy Weather.	12	*N. & W.*	Cloſe, cold Weather.
13	*N. by E.*	Froſty Morn. fair Night.	13	*N. by E.*	Fair, ſun-ſhine Weather.
14	*N. by E.*	Froſt, Snow and Wind.	14	*E. N. E.*	Fair Morning, cloſe Evening.
15	*N. N. E.*	Snow and Wind.	15	*N. E. by E.*	Cloſe, cold Weather.
16	*N. N. E.*	Snow and Rain.	16	*E. by N.*	Cloſe, cold Weather.
17	*N. by E.*	Cloſe, moiſt Weather.	17	*E. by N.*	Cloſe, cold Weather.
18	*W. by N.*	Cloſe Morn. fair Night.	18	*S. & W.*	Variable, dry Weather.
19	*N. E.*	Cold, changeable Weather.	19	Due *S.*	Moiſt Morning, wet Night.
20	*N. N. W.*	Snow, and cold, high Winds.	20	*S. E. & S. W.*	Cloſe, warm Weather.
21	*N. E.*	Cloſe, but fair Weather.	21	*S. E.*	Fair, ſun-ſhine Weather.
22	*N. E.*	Fair Weather, but cold.	22	*S. & N. & E.*	Fair Morning, inclinable to Rain at Night.
23	*E. by N.*	Cold, fair Weather.	23	*S. W.*	Rainy Morning, fair Evening.
24	*E. by N.*	Cold, fair Weather.	24	*S. W.*	Fair ſun-ſhine Weather.
25	*E. by N.*	Cold, fair Weather.	25	*S. W.*	Fair, ſun-ſhine Weather.
26	Due *E.*	Cold, fair Weather.	26	Due *S.*	Cloſe, dry Weather.
27	Due *E.*	Cold, cloſe Weather.	27	*S. W.*	Fair, ſun-ſhine Weather.
28	*S. by W.*	Warm, moiſt Weather.	28	*S. W.*	Cloſe, dry Weather.
29	*S. by W.*	Wind and Rain.	29	*S. W.*	Cloſe, dry Weather.
30	*S. by W.*	Cloſe, fair Weather.	30	Due *S.*	Rainy Morning, fair Evening.
31	Due *S.*	Fair, calm Weather.			

D.	*Wind.*	*Weather*, May 1684.	D.	*Wind.*	*Weather*, June 1684.
1	*S. S W.*	Variable Weather.	1	*S. W.*	Cloſe Morning, fair Evening.
2	Due *W.*	Fair Weather.	2	Due *W.*	Cloſe Morning, rainy Evening.
3	*S. S. W.*	Cloſe, fair Weather.	3	Due *W.*	Fair Morning, rainy Evening.
4	*W. S. W.*	Cloſe, fair Weather.	4	Due *W.*	Cloſe, fair Weather.
5	*W. S. W.*	Moiſt Morning, fair Evening.	5	Due *W.*	Cloſe, fair Weather.
6	*W. S. W.*	Cloſe, fair Weather.	6	Due *W.*	Cloſe, fair Weather.
7	*W. S. W.*	Cloſe Morning, Rain at Night.	7	*W. and N.*	Cloſe, fair Weather.
8	*S.S.E.S.&W.*	Fair, warm Weather.	8	Due *N.*	Fair, ſun-ſhine Weather.
9	*N. W.*	Cloſe, fair Weather.	9	Due *N.*	Cloſe, fair Weather.
10	Due *W.*	Cloſe, fair Weather.	10	*N. E.*	Fair, ſun-ſhine Weather.
11	Due *W.*	Cloſe, fair Weather.	11	Due *E.*	Fair, ſun-ſhine Weather.
12	Due *W.*	Miſty Morning, fair Evening.	12	Due *E.*	Fair, ſun-ſhine Weather.
13	*S. & W.*	Wet Morning, fair Evening.	13	*E. S. E.*	Fair ſun-ſhine Weather.
14	*S. W.*	Cloſe Weather, ſome Rain.	14	*E. S. E.*	Fair, ſun-ſhine Weather.
15	Due *N.*	Cloſe, fair Weather, ſome Wind.	15	*E. S. E.*	Fair ſun-ſhine dry Weather.
16	*N. N. E.*	Windy Morning, cloſe Evening.	16	*E. S. E.*	Fair ſun-ſhine hot Weather.
17	*N. E.*	Cloſe, dry Weather.	17	*E. S. E.*	Fair ſun-ſhine hot Weather.
18	*N. E.*	Cloſe, fair Weather.	18	*E. by N.*	Sun-ſhine Morning, cloudy Evening.
19	*N. E.*	Fair ſun-ſhine Weather.	19	*E. by n. S. ſ. w.*	Sun-ſhine hot Weather.
20	*E. by N.*	Cloſe, fair Weather, ſome Wind.	20	*S. by W.*	A little Rain, cloudy.
21	*N. E.*	Warm Morning, cloſe Evening.	21	*S. e. E. S. E.*	Lowring, ſome Rain.
22	*N. E.*	Cloſe, fair and windy.	22	*N. E.*	Fair, hot Weather.
23	*N. E.*	Cloſe, fair and windy.	23	*N. E.*	Hot, a muddy Sky.
24	*N. E.*	Cloſe Morning, fair ſun-ſhine Evening.	24	*N. E.*	Sun-ſhine, clear.
25	*N. E.*	Cloſe, fair Weather.	25	*N. E.*	Sun-ſhine, fair Weather.
26	*S. E.*	Fair ſun-ſhine Weather.	26	*N. E.*	Sun-ſhine, dry Weather.
27	*N. E.*	Cloſe, fair Weather.	27	*N. E. E.*	Very dry.
28	*E. by N.*	Fair ſun-ſhine Weather.	28	*E. S. E.*	Hot, lowring Evening.
29	*S. W.*	Wind and Rain.	29	*S. S. W.*	Sun-ſhine, clear.
30	Due *W.*	Cloſe, fair Weather.	30	*S. W.*	Cloudy, cool.
31	*S. W.*	Cloſe Weather, a little Rain at Night.			

D.	*Wind.*	*Weather*, July 1684.	D.	*Wind.*	*Weather*, Auguſt 1684.
1	*S.w.W.n.w.*	Somewhat cloudy.	1	*N.*	Warm ſun-ſhine Weather.
2	*W.*	A little Rain, fair.	2	*W.*	Cool, fair Weather.
3	*S. W.*	Fair, but cloudy.	3	*S. W.*	Warm fair Weather.
4	*S. W. W.*	Cloſe, ſome Rain.	4	Due *S.*	Hot ſun-ſhine Weather.
5	*S. W.*	Sun-ſhine Morning, gloomy Evening.	5	*S. W. by S.*	Hot ſun-ſhine Weather.
6	*S. W.*	Cloſe.	6	*S. W. by S.*	Warm ſun-ſhine Weather.
7	*W. S. W.*	Cool, cloſe.	7	Due *S.*	Rainy Morning, fair Evening.
8	*S. W.*	Hazy, ſome Rain.	8	Due *S.*	Cloſe, fair Weather.
9	*W. N. W.*	Some Rain, clear.	9	Due *W.*	Fair; ſun-ſhine Weather.
10	*N. W.*	Clear ſun-ſhine.	10	Due *N.*	Fair, ſun-ſhine Weather.
11	*S. W.*	Rain.	11	*S. W.*	Fair Morn. inclinable to Rain at Night.
12	*W.*	Some Rain, fair Evening.	12	Due *W.*	Rainy Morning, the ſame in the Evening.
13	*W.*	A Shower or two.	13	Due *W.*	Fair, ſun-ſhine Weather.
14	*W. S. W.*	Cool, cloſe Weather.	14	Due *W.*	Fair, ſun-ſhine Weather.
15	*W. S. W.*	Rain.	15	*W.*	Fair, ſun-ſhine Weather.
16	*W.*	Cool, cloſe Weather.	16	*W. N.*	A Shower, ſun-ſhine Weather.
17	*W.*	Cool, cloſe Weather.	17	*N. W.*	Sun-ſhine Morning, cloudy Evening.
18	*N. W.*	Fair ſun-ſhine Weather.	18	*N. n. w. N.*	A muddy Sky in the Morning, ſun-ſhine Evening.
19	*W. S. W.*	Lowring, cool Weather.	19	*N. S. W.*	Fair ſun-ſhine Weather.
20	*W. N. W.*	Fair ſun-ſhine Weather.	20	*S. S. W.*	Hot ſun-ſhine Weather.
21	*W.*	Fair ſun-ſhine Weather.	21	*S. S. W.*	Hot ſun-ſhine Weather.
22	*W.*	Hot ſun-ſhine Weather.	22	*S. W.*	Fair ſun-ſhine Weather.
23	*W. S.*	Hot ſun-ſhine Weather.	23	*S. W.*	Hot ſun-ſhine Weather.
24	*S. E.*	Hot ſun-ſhine Weather.	24	*S. W.*	Hot ſun-ſhine Weather.
25	*E. by S.*	Hot ſun-ſhine Weather.	25	*N.*	Rain all Day.
26	*E. by S.*	Hot, a little Rain towards Night.	26	*S. W.*	Rain at Night.
27	*W. N.*	Hot ſun-ſhine Weather.	27	*N. W.*	Cloſe, ſome Rain.
28	*W.*	Hot, Thunder, Rain.	28	*S. W.*	Cloſe Weather.
29	*N. N. E.*	Cloudy, ſome Rain.	29	*S. S. W.*	Cloſe, Rain at Night.
30	*N. N. E.*	Fair ſun-ſhine Weather.	30	Due *S.*	Variable Weather.
31	*N. E.*	Hot ſun-ſhine Weather.	31	*S. by E.*	Cloſe, ſome Rain.

Wind.

D.	*Wind.*	*Weather*, Septemb. 1684.	D.	*Wind.*	*Weather*, October 1684.
1	*S. by E.*	Cloſe, ſome Rain.	1	*N. W.*	Moiſt Weather, ſome Rain.
2	Due *S.*	Cloſe, ſome Rain.	2	*W. by S.*	Cloſe Weather, but fair.
3	*S. E. W.*	Cloſe, Rain, Thunder.	3	*S. W.*	Cloſe Morning, fair Evening.
4	*S. E. S. W.*	Cloſe, ſome Rain.	4	*S. by W.*	Cloſe all Day, Rain at Night.
5	Due *E.*	Cloſe Morning, rainy Afternoon.	5	*W. N. W.*	Rainy Morning, fair Evening.
6	*S. S. E.*	Cloſe, ſome Rain.	6	Due *W.*	Rainy, windy Weather.
7	*N. W.*	Fair ſun-ſhine Weather, Rain at Night.	7	*S. by W.*	Rain all Day.
8	*N. W.*	Fair, cloſe, dry Weather.	8	*N. N. W.*	Rainy Morning, fair Evening.
9	*N. W.*	Sun-ſhine Morning, cloſe Evening.	9	*N. N. n. w.*	Cloſe, fair Weather.
10	*N. W. N. E.*	Sun-ſhine Morning, ſome Rain.	10	*N. W.*	Fair Weather.
11	*W. by N.*	Fair Morning, cloſe Evening.	11	*S. W.*	Windy, rainy Morning, fair Evening.
12	*N. W. N.*	Fair Morning, ſome Rain at Night.	12	*S. S. W.*	Cloſe, and ſome Wind.
13	*N. N. W.*	Rainy Weather.	13	*S. S. W.*	Cloſe, ſome Rain.
14	Due *N.*	Fair ſun-ſhine Weather.	14	*S. S. W.*	Rain and Wind.
15	*N. by E.*	Fair ſun-ſhine Weather.	15	*S. by E.*	Wind and Rain.
16	Due *N.*	Cloſe, fair Weather.	16	*S. S. W.*	Fair ſun-ſhine Weather.
17	*N. W.*	Cloſe and windy.	17	*S. W.*	Fair ſun-ſhine Weather.
18	Due *N.*	Fair Morning, ſome Rain, fair again.	18	*W. by N.*	Fair Weather.
19	Due *N.*	Fair Morning, cloſe Evening.	19	*N. W.*	Cloſe Morning, fair ſun-ſhine Evening.
20	Due *S.*	Fair ſun-ſhine Weather.	20	*N. W.*	Fair Weather.
21	*S. by E.*	Fair ſun-ſhine Weather.	21	Due *W.*	Fair ſun-ſhine Weather.
22	Due *S.*	Fair ſun-ſhine Weather.	22	Due *W.*	Cloſe, fair Weather.
23	*S. by W.*	Fair Morning, cloſe Evening.	23	Due *W.*	Fair Morning, Wind and Rain at Night.
24	Due *W.*	Fair ſun-ſhine Weather.	24	*N. W.*	Wind, Snow, and Rain.
25	*S. by W.*	Changeable Weather.	25	*N. W.*	Cloſe, cold and windy.
26	Due *S.*	Changeable Weather.	26	*N. W.*	Fair, Froſty Weather.
27	Due *S.*	Rainy Weather.	27	*N. E.*	Froſt and Snow.
28	Due *S.*	Cloſe, moiſt Weather.	28	*S. W. N.*	Froſt and Snow.
29	*S. W.*	Cloſe, moiſt Weather.	29	*N. W.*	Froſty, cold Weather.
30	*N. W.*	Cloſe Morning, ſun-ſhine Evening.	30	*N. W.*	Snow and Wind.
			31	Due *N.*	Cold Thaw in the Morning, clear, froſty Evening.

D.	*Wind.*	*Weather*, Novemb. 1684.	D.	*Wind.*	*Weather*, Decemb. 1684.
1	*S. by W. N.*	Thaw, Snow, Froſt.	1	*N. N. E.*	Froſt, ſun-ſhine.
2	*N. W. W.*	Froſty Morning, Thaw Afternoon.	2	*N.*	Froſt, ſun-ſhine.
3	*S. by W. W.*	Thawing weather all Day.	3	*W. S. W.*	Snow, much ſmall Rain.
4	*N. W.*	Cloſe and windy.	4	*S.*	Cloudy, ſome Rain.
5	*N. W.*	Cloſe and windy, little Froſt.	5	*S.*	Warm, ſun-ſhine Weather.
6	Due *W.*	Fair Weather, little Froſt.	6	*S. e. E. N. E.*	Miſty, thick, moiſt Air.
7	*N. S.*	Fair Morning, rainy Evening.	7	*E. N. E.*	Froſt, ſun-ſhine Weather.
8	*E. by S.*	Small Rain all Day.	8	*E. N. E.*	Moiſt, cloudy Air.
9	*S. E.*	Miſty, moiſt Weather.	9	*E. N. E.*	Moiſt, cloudy Air.
10	Due *W.*	Rainy, miſty Weather.	10	*E. N. E.*	Thick, moiſt Air.
11	*N. W.*	Cloudy, moiſt Weather.	11	*E. N. E.*	Fair, but cloudy.
12	*S. W.*	Cloudy, moiſt Weather.	12	*E. N. E.*	Cloſe.
13	*S. W.*	Cloudy, ſome Sun-ſhine.	13	*E. N. E.*	A moiſt, cloſe Air.
14	*S. W.*	Cloſe, Miſt at Night.	14	*E. S. E.*	Froſt, clear ſun-ſhine.
15	*N. W.*	Froſty Morning, cloſe Evening.	15	*E. W. S. W.*	Froſt, cloudy.
16	*N. W.*	Cloſe Morning, clear froſty Evening.	16	*N. W. N.*	Froſt, cloudy.
17	*N. W. N.*	Hard Froſt and clear.	17	*W.*	Froſt, cloudy, a littl Snow.
18	*N.*	Hard Froſt, ſun-ſhine.	18	*N.*	Froſt, ſun-ſhine.
19	*S.*	Cloſe, Snow, Rain.	19	*W.*	Thaw, cloudy.
20	*S.*	Much Rain.	20	*N. N. W.*	Rain, Hail, Snow.
21	*W.*	Warm ſun-ſhine Weather.	21	*W.*	Froſt, ſun-ſhine.
22	*S.*	Froſt, Rain.	22	*N.*	Froſt, ſun-ſhine.
23	*S. W.*	Fair, ſomewhat warm.	23	*E.*	Hard Froſt, windy.
24	*W. S. W.*	Some Rain.	24	*N. E.*	Froſt, ſun-ſhine.
25	*W. N. W.*	Cloſe, fair.	25	*N.*	Froſt, cloudy, much Snow.
26	*W.*	Fair, warm, cloſe.	26	*N.*	Hard Froſt, ſun-ſhine.
27	*N. W.*	Some Rain.	27	*W.*	Froſt, ſun-ſhine.
28	*N.*	Cold, cloudy, Rain.	28	*N. W.*	Rain all Day.
29	*N. E.*	Fair, but cloudy.	29	*N. W.*	Froſt, Rain at Night.
30	*N.*	Fair.	30	*W. N. W.*	Some Rain, fair Even-ing.
			31	*E.*	Fair, cloudy.

The Weather at Cape Corſe, 1686 *and* 1687, *by Mr.* J. Hillier, n. 232. p. 693.

XXI. At *Cape Corſe* in the Latitude of 4° 49′ N. *An.* 1866. *Nov.* 24 and 25, Clear and hot. 26, About two *a. m.* a Storm of Rain with Thunder for half and Hour. 27, At the ſame Hour, Rain which laſted ſomewhat longer. 28, About five *a. m.* ſome Rain, afterwards miſty, and about ten extream hot. 29, About two *a. m.* a great Storm of Rain ſlacking often, but renewing again, it laſted about an Hour; the Day after, clear.

Thence to *Dec.* 7, clear; then cloudy in the Morning, between twelve and one *p. m.* a Shower laſting about half an Hour: thence clear and hot. 10, A little Miſt in the Morning, otherwiſe very clear and hot; ſo till 15.

15, And ſome Days after, ſomewhat thick, eſpecially in the Morning. 19 and 20, We had a dry North and North-eaſterly Wind, call'd an *Hermitan*, and it overcame the *Sea-Breeze*; found very ill for the Eyes, and moſt Men complained of a feveriſh Temper; it was parching, but rather colder than ordinary. 21, It ceaſed; a clear Air and very hot.

23, We had the *Hermitan* again, but the Morrow it ceaſed: Then and 25, ſome Clouds, but no rain. Thence to 29, clear and hot. 29, The *Hermitan* returned, but did not continue. Thence Clouds ſometimes, but no Rain till *Jan.* 2.

This Month we had three Funerals, one being ſick of the Flux laid violent Hands upon himſelf, through Impatience of the Pain, the third Day. The ſecond, upon the twenty fifth died convulſively, not having been ſick above one Day. The third, *Dec.* 17. Died of a Dropſy, which had ſucceeded a tedious Flux.

An. 1687, *Jan.* 2. About five *a. m.* Rain for half an Hour, between ſeven and nine for an Hour, from half an Hour paſt nine to one *p. m.* the reſt cloudy. 5, At two *a. m.* about half and Hour. 8, At one in the Morning about an Hour, the Days between ſomewhat cloudy: Thence to 12, extream hot.

12 and 14, Somewhat cloudy, otherwiſe the Heat continued. 17, At ſeven *p. m.* a *Tornado* for above half an Hour, and about twelve at Night another; but the Heat very little abated.

22, Between five and ſix *p. m.* began a *Tornado*, which laſted above an Hour very violent, with great Claps of Thunder and Lightning: Tank fill'd one Foot. 23, In the Morning a great Miſt, after eight clear and extream hot.

The latter End of *January*, and the Beginning of *February*, commonly miſty in the Morning; after extream hot.

Feb. 10. Somewhat cloudy and cool, till then we were troubled with Coughs, for the moſt part; about this Time they ceaſed. So the eleventh towards Night, Thunder a far off, and Expectation of a *Tornado*; but it fail'd. 12, Extream hot. 13, A ſtronger Wind than ordinary from Sea-ward. 14. Something like an *Hermitan*, but not from its uſual Quarter; clear and hot till about two *p. m.* then cloudy, but no Rain. Thence to 22, extream hot and clear. From 22 to *March* 1, ſome flying Clouds without Rain; ſultry hot and unwholeſom.

24, Some Shew of a *Tornado*, but it paſs'd away.

This Month we had two Funerals.

The Beginning of *March* as the latter End of *Feb.* 5, From ſix *a. m.* for an Hour and half a violent *Tornado*; the Day after cloudy. 6, Clear. 7, At Night Lightning and Clouds afar off; but nothing followed. Thence to the eleventh, clear and hot.

11, About five *a. m.* a violent Rain for almoſt half on Hour. 12 and 13, Cloudy. 14, About four *a. m.* a gentle Shower, but laſted not long. 15, Between ſix and ſeven *a. m.* a few Drops, and likelihood of more, but nothing followed; both Days cloudy. 16, Extream hot. 17, Somewhat cloudy. Thence to 20, extream hot.

20, Cloudy; about ten *a. m.* ſome few Drops. 21, very hot. 22, In the Morning hot; about twelve a violent Rain for a Quarter of an Hour. 23, Clear. 24, About two *a. m.* Rain for about half an Hour; the Day after clear. Thence to *April* 3, clear and extream hot.

No Funeral.

April 3, At three *p. m.* a violent *Tornado*, but only ſome few Drops of Rain; at five *p. m.* a little Rain. 4, Cloudy by Fits, otherwiſe very hot. 5, Hot and clear. 6, In the Morning hot, about two *p. m.* cloudy; about three ſome Drops of Rain, in the Evening the Clouds diſperſed. 7, Clear and hot. 8, Between twelve and one in the Morning, a violent Rain for near an Hour; after two, one ſomewhat longer; the Day after there appear'd to have been much Rain; Tank fill'd two Foot and ſomewhat more. 9, About ſeven *a. m.* ſome Drops, cloudy all Day.

10, Cloudy about eleven *a. m.* a ſmall Miſt. 11, Preſently after Midnight it began to rain, and laſted till ſix *a. m.* a great Part of the Time very violently, it began with a ſtrong *Tornado*; Tank above three Feet. The Day after ſome Clouds, otherwiſe extream hot. So alſo 12 and 13. 14, About five *a. m.* a Shower for half an Hour, between ſix and ſeven *p. m.* another of the ſame Continuance, the Day between extream hot. So 15, 16, A Shower for half an Hour; it began with a violent *Tornado*, the Rain not much, afterwards cloudy. 17, 18, Clear. 19, Clear alſo, about ſeven *p. m.* a conſiderable Wind, aud Drops of Rain.

20, Clear, but windy. 21, Between twelve and two moderate Rain for near an Hour. 22, About two *a. m.* moderate Rain almoſt an Hour; at eleven *p. m.* a ſhort Shower and gentle; the Day between extream hot. 23, Cloudy, about ten *a. m.* ſome Drops. 24, Extream hot. 25, About one *a. m.* Rain for near an Hour; the Morning after hot; afternoon cloudy; moſt Part of the Night Thunder and Lightning, but no Rain. 26, At ſeven *a. m.* ſtrong Rain for half an Hour, after that a litttle Miſt; Afternoon from twelve to three it rained unequally, but the moſt part moderate. 27, Extream hot. 28, About twelve ſomewhat cloudy, at three *p. m.* it began to rain, and laſted about an Hour and an half; after, cloudy and ſome Drops, in the Night a Shower or two. 29, Cloudy. Thence to *May* 6, ſometimes cloudy; but for the moſt part violent hot.

This Month we had three Funerals; one on the third of a Fever, another on the nineteenth of I know not what Pains in the Guts; another on the twenty-fourth of the Flux.

The fifteenth, and ſome Days following, there ſettled upon the Caſtle Walls certain Swarms of winged Ants, a little bigger than Bees; they would bite very ſeverely, and were blown up with Powder.

May 6, in the Morning a little cloudy, Afternoon ſome Wind, followed by gentle Rain, which laſted till three *p. m.* after, Cloudy. 7, Hot. 8, Cloudy; about ten *a. m.* a gentle Shower for three Quarters of an Hour; about eight *p. m.* a very violent Storm of Wind and Rain, but it quickly grew moderate, and laſted in all not above half an Hour. 9, Clear. 10, About Noon a violent Shower for a Quarter of an Hour; after eight *p. m.* another as long, but not ſo violent; paſt nine, another ſhorter.

11, Clear. 12, Clear; paſt nine *p. m.* a very violent *Tornado* with Rain, which laſted ſomewhat more than two Hours. 13, Between twelve and one in the Night a ſhort Shower; about nine *a. m.* ſome Drops; ſo alſo in the Afternoon, but nothing conſiderable; cloudy all Day. 14, Cloudy; at nine *a. m.* a violent Rain for a Quarter of an Hour; after, gentle for above an Hour; about three *p. m.* ſome Drops. 15, About three *a. m.* Rain for half an Hour; between four and five, another; after, foggy and cloudy, with ſome few Drops; about ſeven *p. m.* a violent *Tornado* with Rain for near an Hour. 16, About four *a. m.* Rain for an Hour; after eight, for a Quarter of an Hour; after ſix *p. m.* Rain and Wind, but both moderate, for half an Hour; paſt eight, about as much. 17, About four *a. m.* a ſhort Shower; after clear. 18, Clear. 19, Cloudy; about ten *a. m.* ſome Drops.

20, Cloudy; between eight and ten *a. m.* a Shower; firſt violent, after more moderate, till it ended in a kind of Miſt; it laſted in all about an Hour and half; the Day after clear. 21 and 22, Clear. 23, In the Afternoon cloudy; about ſix *p. m.* ſome Drops; the Night after, a Shower not conſiderable. 24, Hot, about ten *p. m.* a little Shower. 25, Clear. 26, In the Night, ſome little Rain. 27, Held up. 28, At nine *p. m.* a ſhort Shower. 29, At five *a. m.* Rain till near ſeven; a little paſt ſeven till nine, after cloudy. 30, Cloudy; the Night after ſome Rain. 31, About eight *a. m.* Rain for half an Hour; from nine till twelve it rained for the moſt part very violently; before one, another Shower for half an Hour; from a little after two till five, with very great Thunder.

One Funeral on the twenty fifth, after but three Days Sickneſs.

The Beginning of this Month we had an extraordinary Number of Toads, which after ſome time were not to be ſeen. The fourteenth we had winged Ants as before.

24, Was the firſt Corn, the Seed-time having been the middle of *March*.

June 1, About four *a. m.* Rain for an Hour; paſt one *p. m.* for half an Hour; the reſt cloudy and miſty. 2, From two *a. m.* till five, continual Rain, 'tis ſaid there was ſome before; from nine *a. m.* till half an Hour paſt ſix *p. m.* continual Rain, ſometimes very fierce; from half an Hour paſt nine at Night, Rain till paſt ten. 3, From ſix to a little paſt ſeven *a. m.* a very gentle Rain, from thence till one *p. m.* moſt commonly very fierce; thence for a little while, more moderate; but it rained hard again till ſix *p. m.* then it dropped but ſlowly, and ſo continued till about ſeven; in the Night ſome little Rain. 4, About eight *a. m.* ſome Drops, thence clear. 6 and 7, Clear, except ſome few flying Clouds. 8, After three *a. m.* gentle Rain for near an Hour; then cloudy, and ſome Drops, after ten *p. m.* a Shower. 9, At five *a. m.* a gentle Shower, laſted till paſt ſeven; thence a very violent Rain till almoſt nine; ſome Drops after that; about three *p. m.* it began, and rained till paſt ten ſomewhat moderately. 10, Clear and hot.

11, Cloudy; about eight *p. m.* a few Drops. 12, From about two *a. m.* till near five, Rain, but not violent; a little before ſix, a furious Storm of Rain, but little Wind, it laſted till half an Hour paſt ſeven. About three *p. m.* a moderate Rain till a little paſt four; and from thence to ſix ſomewhat more than a Miſt, the Night after it rained a little. 13, Cloudy, in the Afternoon it dropp'd a little. 14, About eight *a. m.* a few Drops. 15, Somewhat cloudy. 16, Extream hot, towards Night cloudy, about five *p. m.* a violent Shower for half an Hour; from a little before eight till paſt ten it rained continually. 17, From four *a. m.* till almoſt ſix, gentle Rain; ſo from a little paſt ſix till paſt ſeven, thence till paſt three *p. m.* cloudy, and now and then ſome Drops, then a violent Shower for half a Quarter of an Hour; half an Hour after four it rained again, and continued till paſt ten, for the moſt part very furiouſly; with ſome little Intermiſſion it rained all Night. 18, At three *a. m.* it rained very fiercely; about half an Hour after ſix it held up, but cloudy ſtill; from eight *a. m.* till paſt three *p. m.* it rained, but moderately; then it held up a little, but rained after till paſt ſix, all Day cloudy, and at Night a great Fog. 19, About nine *a. m.* ſome Drops; from one till paſt three *p. m.* very gentle Rain.

Thence to the firſt of *July* foggy Morning and Evening, ſometimes hot, but for the moſt part cloudy, and more temperate than could be expected from the Climate.

Two Funerals, one the ninth, of an Aſthma; the other the twenty firſt, of a Fever.

We ſaw ſome ſorts of Inſects not uſual here, whether monſtrous or not I cannot tell; the moſt notable, a kind of Spider about the Bigneſs of a Beetle, the Form neareſt that of a Crab-Fiſh, with an odd kind of Orifice viſible in the Belly, whence the Web proceeded.

July 1, Extream hot. 2, Foggy in the Morning; about nine *a. m.* a few Drops; after, clear. 3, In the Morning a great Fog; about nine *a. m.* it rained ſmall Rain for near an Hour; towards Night more foggy than ever before; about ſix *p. m.* ſmall Rain for a little time, from eight till paſt nine ſomewhat more briſk Rain, after that it cleared up. 4, From nine *a. m.* to three *p. m.* ſmall Rain, the reſt foggy; between ten and eleven *p. m.* ſome Rain. 5, From two, *a. m.* till paſt eight, conſtant Rain, ſometimes very fierce, ſometimes moderate; about ten *a. m.* ſome Rain; between two and three *p. m.* it began to rain, but continued not long; from eight *p. m.* to ten, Rain. 6, From about two *a. m.* to ſix, Rain; after, fair. 7, Foggy and cloudy, between ſeven and eight *a. m.* ſome Drops. 8, Foggy in the Morning, otherwiſe clear and hot. 9, About one *a. m.* a ſmart Shower; between three and five ſome more Rain; the Day after foggy. 10, Very dull and cloudy; from three *p. m.* till Night, a very great Miſt. 11, 11, Tolerably clear, and very hot, yet ſomewhat foggy Morning and Evening. 12, Cloudy; thence to 15, in the Morning and Evening foggy, elſe very hot. 15, Cloudy; about ten *a. m.* ſome Drops; from half an Hour paſt two till four, moderate Rain; about ſeven, ſome Drops; cloudy, ſeveral times it dropped a little, but nothing conſiderable. 17, A little before Day a ſhort Shower; after, cloudy; thence to 20, foggy Morning and Evening, and the moſt part cloudy.

20, Very clear all Day, and extream hot. 21, Not foggy at all; yet ſomewhat cloudy, but about Mid-day it cleared up. 22 and 23, Very clear and extream hot. 24, Cloudy in the Morning; after, as the two laſt. 25, Cloudy, but not miſty nor foggy; ſultry hot. 26, In the Morning cloudy; after, extream hot. 27, Hot and clear. 28, Thin Clouds, through which the Sun ſhone very hot. 29 and 30, Cloudy. 31, About three *a. m.* two ſhort Storms of Rain; the Day after, clear and hot.

Two Funerals; one the ſeventeenth drowned, the other the twenty-firſt of a Fever.

Aug. 1 to 5, Clear, for the moſt part in the Mornings cloudy; but without Fogs, ſometimes very hot. 5, About five *a. m.* a Shower near an Hour long; about ſeven, another for half an Hour; till ten, ſome ſmall Rain; thence cloudy till one; about ſeven *p. m.* a few Drops. 6, Cloudy all Day, ſometimes it dropp'd a little. 7, About two *a. m.* violent Rain with Wind for above half an Hour; the Day after, cloudy. 8 and 9, Cloudy and foggy. 10, More foggy than ordinary; about ten *a. m.* a great Miſt, or ſmall Rain for the moſt part of the Day after.

11, Foggy, as the former, and miſty; between eight and nine *a. m.* a Shower of ſmall Rain; Afternoon, clear. 12, Small Rain in the Morning; after, as 11. 13, Clear and hot, the *Land Breeze* very ſtrong. 14, Cloudy all Day, the *Land Breeze* turn'd to a kind of *Hermitan*, but not troubleſome, nor continued beyond this Day. 15, Cloudy, ſeveral Times very miſty, and ſome ſmall Rain. 16, Cloudy, but no Miſt; Afternoon, clear: Thence to 22, clear and hot; but the Nights colder than at other Times.

22, At ſix, *p. m.* Cloudy, a Wind *Tornado*, but moderate, with ſome Drops of Rain very large. 23, Clear and hot. 24, Cloudy and miſty at firſt; about ten *a. m.* clear and hot. 25, Clear and hot. 26, Very foggy, Morning and Evening; for the reſt, hot. 27, From five to ten *a. m.* it rained ſmartly; thence cloudy; about two *p. m.* it cleared up for a while; about nine *p. m.* a ſharp Rain for half an Hour. 28, Between twelve and three *a. m.* it rained about two Hours; about ſeven ſome few Drops; after, cloudy; in the Middle of the Day it cleared a little, but quickly overcaſt again. 29, In the Night ſome Rain; at ſeven, *a. m.* Rain for half an Hour; till paſt twelve, a very thick Miſt; about three *p. m.* clear; at Night a very thick Miſt. To the End, cloudy and miſty.

Three Funerals; 6, one of a Fever; 7, another of a Conſumption; 29, a third of a Fever.

Sept. 1 and 2, as the laſt. 3, Some few Drops: Thence to 8, cloudy alſo and miſty. 8, About ſix *p. m.* ſome ſmall Rain; between eight and ten *p. m.* for an Hour pretty briſk Rain. 9, In the Morning cloudy and miſty. 10, About ten *p. m.* a little Rain.

11, Extream hot and clear; in the Night conſiderable Rain for ſeveral Hours. 12, About ten *a. m.* ſome ſmall Rain, the Morning very foggy, Afternoon clear. 13, Clear and hot. 14 and 15, In the Morning extream cloudy, and ſome Drops of Rain. 16, Clear and extream hot. 17, Moderate; about ſeven *p. m.* ſome Drops; at Night alſo ſome Rain, not conſiderable. 18, Cloudy; in the Morning about twelve, ſome Drops; all this Week, Morning and Evening, foggy and thick. 19, 20, 21, Extream hot; the fogs ceaſed.

22, About one *a. m.* ſome Rain; the Day after cloudy. 23, 24, 25, in the Morning cloudy; after, very hot. 26, At Night alſo ſomewhat miſty, with many Flaſhes of Lightning, but no Thunder. The like Flaſhes moſt Nights to the End of the Month, alſo often cloudy; at other Times extream hot.

Two Funerals; one the nineteenth of a Fever; the other the twenty-ſixth, whoſe Diſeaſe I do not know.

October 1, About three *a. m.* a very fierce Rain for near an Hour, milder towards the End; the Day after, ſome flying Clouds. 2, About four, *a. m.* a little Rain, the Day after, as before; from eight *p. m.* till ten, moderate Rain. 3, Cloudy; about ten *a. m.* Rain for ſomewhat more than an Hour. 4, Cloudy; between eight and ten *p. m.* a very ſmart Rain for above an Hour. 5, About nine *a. m.* a little Shower. 6, About five, *a. m.* a little Shower; another paſt ſix: The Day after, and the ſeventh, extream hot. 8, Hot in the Morning; Afternoon, a Shew of a *Tornado*, with Thunder, and a conſiderable Wind, but no Rain.

Thence to 16, ſome flying Clouds, but generally hot. 16, About four *p. m.* a little Rain, the Sun ſhining then, and the whole Day, very hot; about eight *p. m.* a very ſtrong *Tornado*, Wind and Rain for about half an Hour, afterward the Rain continued, but more moderate, for near two Hours. 17, Clear and hot. 18, So too, except that about three *p. m.* there was a very ſhort Shower. 19 and 20, Somewhat cloudy.

21, About ſeven *a. m.* a few Drops; after, clear and extream hot, but quickly cloudy again; at eleven *a. m.* a violent *Tornado*, with very ſtrong *Rain* and *Thunder* for near an Hour; thence all the Time till Night, thick and miſty; till two *p. m.* Rain. 22, Cloudy. 23, Clear and hot. 24, Somewhat cloudy; at ſeven *p. m.* a little Rain. 25, Cloudy; about eleven *a. m.* Expectation of a *Tornado*, with ſome *Thunder*, but it ended in a few Drops of Rain about one *p. m.* 26, About two *a. m.* a very violent *Tornado*; and after the Wind, Rain not very fierce, which laſted till eight *a. m.* the Day after cloudy. 27, About ten *p. m.* a violent Wind with Rain, but it laſted not long. 28, About three *a. m.* a ſtrong Rain for near an Hour, the Day after extream hot. 29 and 30, Hot, yet with ſome Clouds. 30, Half an Hour after eleven *p. m.* began a very furious *Tornado*, the Wind was quickly over, but the Rain laſted with extream Violence about two Hours. 31, In the Morning very hot, about two *p. m.* a violent *Tornado*, with *Rain* and *Thunder* very near, it ceaſed ſometimes, but beginning again, laſted till near four *p. m.* afterward cloudy.

Three Funerals, all upon the ſixth Day; two of Fevers, the other I know not.

Nov. Clear and extream hot till the ſixth. 6, About half an Hour paſt one in the Morning, a very violent Rain for more than Hour.

Thence to 14, except that the eleventh at Night there were ſome few Drops, very hot.

14, Extream hot, about nine *p. m.* a little Shower; the ſame Night about one, a ſmart Rain for an Hour and half. 15, Hot; toward Night cloudy and foggy: Thence to 19, very hot. 19, Some likelihood of a *Tornado*, but nothing followed.

20, About one *p. m.* a ſhort Shower; about a Quarter paſt two, another not much longer; till Night cloudy. Thence to 26, no Rain, but cloudy and ſomewhat cooler; yet ſome Days extream hot. 26, About ten *p. m.* a ſhort Shower. 27, About two another, the reſt clear. 30, About two *a. m.* fierce Rain for about half an Hour.

This laſt Year has been the wetteſt and moſt cloudy of any that can be here remembred; yet the Air has been clearer than it uſes to be in *England* one Day with another. *Ib.* p. 691.

A *Tornado* is a violent Storm of Wind, followed commonly by Rain, but not always; the Wind ceaſes not preſently upon the Rain, but after, ſometimes it does: In this Place it comes (as does an *Hermitan*) moſt frequently from the North, taking in the next Points, whether to the Eaſt or Weſt, but chiefly the Eaſt, tho' I have ſeen both that and an *Hermitan* from other Points; ſo the Account is not without Exception. There are in it ſhort uncertain Blaſts from all Quarters, which I believe reach not many Yards; but the general Wind (for ought that I ſee) is not ſo unconſtant: Veſſels that go to Windward are helped by them, when they are not over-ſtrong, for they are oppoſite to the *Sea-Breeze*, and they can ſteer by them a regular Courſe; which ſure they could not do, if they were very irregular. They never fail to give Warning before-hand, tho' ſometimes after that Warning they do not follow; there is a very black Cloud appears afar, in which if there be a kind of white Spot, the Wind will be moſt; if not, the Rain: this the Sailors ſay. Sometimes there is that Mark, ſometimes not; though I doubt the Prediction from it is not very certain; as neither are any perhaps of that kind. *Ib.* p. 692.

XXII. *The*

XXII. *The Rain at Greſham College, 1695 and 1696, n. 223. p. 357.*

M.	*D.*	℔	*Oun.*	*gr.*	*M.*	*D.*	℔	*Oun.*	*gr.*	*M.*	*D.*	℔	*Oun.*	*gr.*
Auguſt	19	2	6	216	*Jan.*	6	4	10	105	*May*	4	4	10	45
	26	4	6	246		13	0	1	12		11	7	6	0
						20	1	10	450		18	5	2	105
Septemb.	2	0	4	96		27	1	5	82		25	1	7	60
	9	3	10	397										
	16	0	1	204	*Feb.*	3	6	11	372	*June*	1	0	0	99
	23	0	6	336		10	4	9	242		8	6	6	150
	30	4	1	444		17	0	6	291		15	0	2	120
						24	0	2	180		22	7	5	285
October	7	2	3	96							29	1	5	84
	14	0	2	60	*March*	2	0	9	12					
	21	0	1	234		9	0	2	459	*July*	6	0	1	120
	28	0	0	458		16	0	0	396		13	16	1	0
						23	4	4	263		20	1	7	240
Novemb.	4	0	0	207		30	1	5	285		27	6	1	256
	11	1	11	65										
	18	1	1	309	*April*	6	2	4	375	*Auguſt*	3	1	10	120
	25	0	9	285		13	1	0	294		10	1	11	90
						20	2	2	000		12	0	0	0
Decemb.	2	0	8	126		27	0	7	390					
	9	3	7	324										
	16	1	3	435										
	23	0	1	60										
	30	5	8	93										

This Account of the Quantities of Rain fallen in one Year in *Greſham College*, *Lond. per* Month, begun *Aug.* 12, 1695, and the Rain was weigh'd every *Monday* Morning till *Auguſt* 12, 1696, by Pounds, Ounces and Grains, *Troy* Weight: The Diameter of the Veſſel which receives the Rain being 11,4 Inches, whoſe *Area* is a little more than 102,1 Inches.

℔. *Oun. gr.*

The Sum amounted to 131 7 113, which is equal to 29,11 Inches in a Cylinder of the aforeſaid Diameter, *viz.* 11,4 Inches.

Fig. 18. *ABCD* is a Frame to ſupport the Glaſſes. *E* is a large Bolt-head, with a Neck of twenty Inches long, and capable of holding above two Gallons. *F.* is a Funnel, whoſe Diameter is eleven Inches and $\frac{4}{10}$ from *G* to *H*. *I, K,* are two Stays, or Pack-Threads which are ſtrained by two Pins, *L, M,* to hold the Tunnel ſteady againſt the high Winds. *N*, the Pipe of the Tunnel, at *N* being no wider than ¼ of an Inch, through which the Evaporation can be but little.

XXIII. *The Weather* 1697 *at* Upminſter *in* Eſſex; *by* Mr. Will. Derham, n. 237. p. 47.

JANUARY, 1697.

D.	*h.*	*Weather.*	*Winds.*	*Barom.*	*Rain.*
	8	Froſt	W. S. W.	30 07	
1.	12			30 07	
	9	Fair		30 04	
	8			30 05	
2.	12	Miſling	S.	30 06	
	9			30 05	
	8	Fog	S. by W.	30 07	
3.	12	Cloudy	S.	30 11	
	9			30 15	
	8			30 18	0 50
4.	12	Miſling	S.	30 18	
	9			30 18	
	8	Calm		30 22	
5.	12	and	W. by S.	30 23	
	9	Cloudy	S. W.	30 26	
	8	Fog		30 22	
6.	12	Warm	W.	30 00	0 30
	9	Miſling		30 14	
	8		N. by W.	30 05	
7.	12	Cloudy	N. W.	30 05	
	9				
	8		N. W.	29 94	
8.	12	Cloudy	N. W.	29 90	
	9			29 82	
	8	Sun-ſhine		29 51	
9.	12	Rain	S.	29 38	
	9	Snow		29 10	1 20
	8	Froſt	S. W.	29 02	
10.	12	Thaw	S.	29 00	
	9	Rain	S. by E.	28 95	0 70
	8	Cloudy		29 40	
11.	12	Fair	N.	29 00	
	9			29 77	
	8		N.	29 83	
12.	12	Sleet			
	9				
	8				
13.	12	Cloudy			
	9			29 91	
	8		N. E.	29 95	
14.	12	Snow	N. E.	29 96	0 20
	9		E. N. E.	29 98	
	8	Froſt	E. N. E.	29 94	
15.	12	Cloudy	E.	29 92	
	9			29 90	
	8	Froſt	E. N. E.	29 90	
16.	12	Cloudy	N.e.b.N.	29 91	
	9			29 94	
	8	Froſty	N.	30 02	
17.	12	Cloudy	N. N. W.	30 02	
	9	Calm		30 04	
	8	Froſt	W.	30 09	
18.	12	Fair	S. W.	30 10	
	9			30 10	
	8				
19.	12				
	9				
	8	Fair			
20.	12	Froſt			
	9	Cloudy	S.w.b.w.	30 20	
	8				
21.	12				
	9				
	8	Cloudy	W.	29 95	
22.	12	Thaw	W. by N.	29 90	0 08
	9	Rain		29 95	
	8	Froſt	N. W.	29 90	
23.	12	Snow	N. W.	29 80	0 30
	9	Fair	N. N. W.	29 68	
	8	Snow	N.w. by w.	29 64	
24.	12	Storm	N.	29 67	0 20
			N. E.	29 78	
	8	Snow	N. by E.	29 95	
	8	Froſt	E.	29 95	
25.	12	Fair	E. by N.	29 97	
	9		N. E.	29 98	
	8	Sharp	N. E.	29 96	
26.	12	Froſt	N. by E.	29 96	
	9		N. N. E.	29 86	
	8			29 77	
27.	12	Froſt	N. E.	29 77	
	9			29 74	
	8	Cloudy	S.	29 65	
28.	12	Froſt	N. E.		
	9			29 60	
	8	Snow	S.	29 47	
29.	12	Thaw	S. W.	29 31	0 08
	9			29 29	
	8	Froſt	S. W.	29 41	
30.	12	Fair	W.	29 50	
	9		W. by S	29 54	
	8	Froſt	W.	29 77	0 05
31.	12	Fair	N. N. W.	29 86	
	9		N. by W.	29 95	
				Total	3 61

FEBRUARY, 1697.

D.	h.	Weather.	Winds.	Barom.	Rain.
1.	7				
	12	Froſt			
	9			30 06	
2.	7	Cloudy		30 05	
	12		N. E.		
	9	Froſt		29 95	
3.	7	Cloudy	N.E.b.E.	29 75	
	12	Froſt	E.	29 66	
	9	Calm	S.	29 50	
4.	7	Cloudy		29 30	0 02
	12	Thaw	E. by S.	29 26	
	9	Sleet		29 20	
5.	7	Snow		29 20	0 03
	12	Fair	E.	29 20	
	9	Froſt		29 19	
6.	7	Froſt	N. by E.	29 05	0 03
	12	Cloudy		29 02	
	9	Snow	N.	28 90	
7.	7	Snow	N.	28 86	0 01
	12	Cloudy	W. by S.	28 83	
	9		S. by W.	28 83	
8.	7	Fairer		28 82	0 01
	12	Sleet	S. W.	28 84	
	9			28 97	
9.	7	Thaw		29 10	
	12	Froſt	S. W.	29 18	
	9			29 25	
10.	7	Froſt	S. W.	29 43	
	12	Fair	S.w.b.w.	29 52	
	9			29 61	
11.	7	Snow	S. by E.	29 65	0 29
	12	Rain	S. E.	29 76	
	9	Fair	E.	29 91	
12.	7	Cloudy	E. by S.	30 08	
	12	Froſt			
	9			30 08	
13.	7	Thaw		30 00	
	12	Warm	S.	30 00	
	9	Cloudy		29 95	
14.	7	Calm	S.	29 88	0 40
	12	Rain	S. by W.	29 87	
	9		S.	29 80	
15.	7	Miſt	N.	29 85	0 30
	12	Warm	N. W.	29 86	
	9	Rain	E.	29 80	
16.	7	Cloudy	S. by E.	29 54	0 25
	12		W.S.W.	29 62	
	9	Fair		29 60	
17.	7	Rain		29 50	0 20
	12	Fair	S.	29 52	
	9	Rain		29 52	
18.	7	Cloudy	S. by E.	29 3	
	12	Bluſtring	S.	29 26	
	9	Fair		29 42	
19.	7	Rain	E. by S.	29 30	0 05
	12		S.	29 33	
	9	Fair		29 39	
20.	7		S. E.	29 46	
	12	Froſt	E. by S.	29 46	
	9		E.	29 40	
21.	7			29 36	
	12	Fair	E.	29 37	
	9			29 45	
22.	7	Rain		29 47	0 03
	12		E.	29 48	
	9	Fair		29 52	
23.	7	Hoar-Fr.	E.	29 52	
	12	Fair	S.	29 54	
	9	Rain	S.	29 60	
24.	7			29 68	0 04
	12	Fair	S. by W.	29 75	
	9	Rain		29 81	
25.	7	Cloudy		29 84	
	12	Bluſtring	S.	29 85	
	9	Fair		29 88	
26.	7	Fair	S.	29 88	0 10
	12	Cloudy			
	9	Rain	S. W.	29 92	
27.	7	Miſling	S.	29 93	
	12	Fair	S. by W.	29 97	
	9	Calm	S. S. W.	29 98	
28.	7	Cloudy		30 01	0 03
	12	Fair	S. W.	30 01	
	9	Cloudy		30 40	
				Total	1 80

MARCH, 1697.

D.	h.	*Weather.*	*Winds.*	*Barom.*	*Rain.*
	7	Cloudy		30 12	
1.	12		S. W.		
	9	Fair		30 20	
	7	Cloudy	W.S.W.	30 18	
2.	12	Warm	S. W.	30 19	
	9	Spring		30 14	
	7	Fog	S.	30 02	
3.	12		W.	29 95	
	9	Fair	W. by S.	29 88	
	7	Miſt		29 75	
4.	12	Rain	S. W.	29 69	0 13
	9	Fair		29 65	
	7	Fair	S. W.	29 71	
5.	12	Colder		29 70	
	9		S.	29 46	
	7	Rain	S. W.	29 20	
6.	12	Bluſtring	W.	29 12	0 85
	9	Fair		29 21	
	7	Fair	W.	29 48	
7.	12	Colder	W.by N	29 57	
	9	Bluſtring	W.	29 60	
	9	Froſt	N. W.	30 01	
8.	12		N.	30 11	
	9	Fair	N. by E.	30 15	
	7	Froſt	E.	30 15	
9.	12		W.	30 14	
	9	Fair	S. W.	30 08	
	7	Miſt	S. W.	29 95	
10.	12		S.w.byS.	29 90	
	9	Fair	S. by W.	29 76	
	7	Miſt	S.	29 65	
11.	12	Froſt	W. by S.	29 64	
	9	Cloudy		29 60	
	7	Rain	N. W.	29 47	
12.	12	Fair	W. S.W.	29 35	
	9	Rain	W. byN.	29 21	
	7		N by W.	29 18	
13.	12	Rain	N.	29 25	0 32
	9		N.	29 35	
	7	Froſt	N.	29 59	
14.	12	Fair	W.	29 60	0 02
	9	Cloudy	W.	29 48	
	7	Fair		29 40	
15.	12	Bluſtring	W.	29 48	
	9	Storms		29 28	
	7	Fair		29 04	
16.	12	Hail	W.	29 04	0 82
	9	Snow		28 93	
	7	Froſt		29 16	
17.	12		N. W.	29 30	
	9	Fair		29 32	
	7	Froſt	S.	29 10	
18.	12	Snow	N. W.	29 10	
	9		W.	29 16	
	7	Froſt	W. by S.	29 27	
19.	12	Fair	N. W.	29 41	
	9		S.W.b.S.	29 43	
	7	Froſt	S.	29 42	
20.	12	Snow	S. S. E.	29 37	0 52
	9	Fair	S. E.	29 25	
	7	Bluſtring	E. by N.	29 07	
21.	12	Cloudy	E. by N.	29 10	
	9	Hazy	N. N. E.	29 24	
	7				
22.	12				
	9				
	7				
23.	12				
	9	Froſt	N. E.	29 40	
	7	Froſt	N.	29 46	
24.	12		N.N.W.	29 54	
	9	Fair	N. by E.	29 70	
	7	Froſt	N.byE. 1	29 78	
25.	12		S. 1	30 02	
	9	Fair	S. 0	30 11	
	7	The	E 0	30 11	
26.	12	ſame	S.e.bye. 1	30 10	
	9			30 04	
	7			29 97	
27.	12	Same	E. 0	29 98	
	9			30 07	
	7	Same	E. 0	30 13	
28.	12	Hazy	E. 0	30 15	
	9		E. 1	30 20	
	7	Cloudy	n.e.b.n. 0	30 14	
29.	12	Cold	N.N.e. 1	30 12	
	9			30 12	
	7	Cloudy	N. 1	30 12	
30.	12	Warmer	N. N. E.	30 12	
	9			30 05	
	7	Cloudy	N. 1	29 96	0 02
31.	12				
	9	Rain	N. by E.	29 88	
				Total	2 68

APRIL, 1697.

D.	h.	Weather.	Winds.	Barom.	Rain.
1.	6	Cloudy		29 83	
	12	Warm	N. E. 0	29 83	
	9	Fair		29 84	
2.	6		N. 1	29 88	
	12	Fair	N. E. 2	29 88	
	9			29 87	
3.	6	Fair	N.e.b.e.1	29 83	
	12	Want of	E. 1	29 82	
	9	Rain		29 82	
4.	6	Misling	N. 0	29 75	
	12	Cloudy			
	9	Fair		29 68	
5.	6	Cold		29 68	
	12	Fair	N. by E.	29 68	
	9	Misling		29 74	
6.	6	Froſt		29 73	
	12		E.	29 71	
	9	Fair		29 68	
7.	6	Froſt		29 66	
	12	Dry Sea-	E.	29 67	
	9	ſon		29 70	
8.	6	Froſt		29 71	
	12		E.	29 70	
	9	Warmer		29 71	
9.	6	Fog	W.	29 66	
	12	Fair	W.	29 64	
	9	Cloudy		29 64	
10.	6	Warm	E. 0	29 61	
	12	and	E.byS. 1	29 61	
	9	Fair		29 60	
11.	6	Fair	E. 0	29 60	
	12	Warm	E. 1	29 63	
	9	Cloudy	N.byE.2	29 64	
12.	6	Fair	N.N.E.2	29 65	
	12	Cloudy	N. by E.	29 67	
	9	Rain		29 70	
13.	6	Cloudy		29 72	
	12	Rain	N. E.		2 38
	9			29 78	0 30
14.	6		N.n.e. 0	29 75	
	12	Fair	E.byN.0	29 76	
	9			29 76	
15.	6	Fair		29 77	
	12	Warm	E. 1	29 77	
	9	Spr. Day		29 73	
16.	6	Fair	E. 0	29 73	
	12			29 75	
	9	Cloudy	N. 0	29 86	
17.	6		N.b.w. 1	29 96	
	12	Fair		29 96	
	9		N. 1	29 04	
18.	6	Fair	N. 0	29 91	
	12	Hot	E. N. E.	29 93	
	9	Day		29 95	
19.	6			29 93	
	12	The	E. 1		
	9	ſame		29 80	
20.	6	The	E. 0	29 69	
	12	ſame	S. 1	29 60	
	6		S. 0	29 52	
21.	6	Cloudy	E.byS. 0	29 35	
	12	Fair	E.byS. 1	29 21	0 43
	9	Rain	S by E. 1	29 10	
22.	6	Cloudy	E. 1	29 08	
	12	Rain	S. 1	29 05	0 30
	9	Fair	S. E. 0	29 15	0 62
23.	6	Fair	E. 0	29 20	
	12	Rain	S.byE. 1	29 22	0 06
	9	Fair	S. E.	29 27	
24.	6	Rain	S. E. 1	29 31	
	12		N.N.W.	29 32	1 24
	9	Thunder	E.	29 34	
25.	6	Showers	E. by N.	29 28	
	12		E.	29 27	0 75
	9	Fair	E. 0	29 18	
26.	6	Cloudy	S.	29 14	0 65
	12				
	9				
27.	6				
	12				
	9				
28.	6				
	12				
	9				
29.	6				
	12				
	9				
30.	6				
	12				0 80
	9				
				Total	7 53

MAY, 1697.

D.	h.	Weather.	Winds.	Barom.	Rain.
	6	Cloudy			
17.	12	Miſling		29 65	3 0
	9	Bluſtring	S. W. 2	29 55	
	6	Rain	W. 2	29 57	
18.	12	Fair	W.b.n. 1	29 65	0 19
	9			29 74	
	6		W.b.S. 1	29 79	
19.	12	Fair	E. 1	29 85	
	9			29 92	
	6	Fair	E.b.N. 0	29 99	
20.	12		N. 2	30 02	
	9	Cool	N.b.E. 0	30 07	
	9	Cloudy	N. 0	30 08	
21.	12	Cold	N.b.E. 1	30 08	
	9	Fair	N.b.E. 0	30 11	
	6	The	N.b.E. 0	30 07	
22.	12	ſame	N.b.E. 0	30 07	
	9		E. 0	30 02	
	6	Cloudy	E.	29 98	
23.	12	leſs Cold	N.b.N. 0	29 93	
	9	Fair	E.b.N. 0	29 88	
	6	The	N.b.E. 0	29 85	
24.	12	ſame			
	9		E. 0	29 88	
	6	Miſt		29 88	
25.	12	Hot and	E. 0		
	9	Dry		29 85	
	6	The	E. 0	29 83	
26.	12	ſame	E. 0	29 80	
	9		E. 0	29 73	
	6	Fair	N. 0	29 65	
27.	12	Little	N. 0	29 65	0 01
	9	Rain		29 75	
	6	Fair	N. 0	29 82	
28.	12	Warm			
	9		S. 0	29 74	
	6	Fair	S. 0	29 79	
29.	12	Hot	E. 0	29 75	
	9		E. 1	29 73	
	6	The	E.	29 73	
30.	12	ſame		29 76	
	9		S. 0	29 80	
	6	The		29 80	
31.	12	ſame	S. 0		
	9			29 75	
				Total	3 20

JUNE, 1697.

D.	h.	Weather.	Winds.	Barom.	Rain	D.	h.	Weather.	Winds.	Barom.	Rain.
	6	Fair		29 66			6	Cloudy	N.	29 90	
1.	12	Hot	S. 0			17.	12	Fair	W. 1	29 92	
	9	Rain		29 56			9	Sultry	W. 0	29 94	
	6	Rain	S. 0	29 42			6	Very	W.b.S. 0	29 98	
2.	12	Shine	S. 1	29 29	0 44	18.	12	drough-	W.b.S. 1	30 00	
	9	Rain	S. 1	29 10			9	ty	S. W. 0	30 00	
	6	Fair	S.b.W.	29 08	0 79		6	Hot	ſ.w.bw.2	29 93	
3.	12		S. 1	29 04		19.	12		W.b.e. 1	29 91	0 22
	9	Showers	S. 1	29 02	1 37		9	Rain	N. E. 0	29 93	
	6		S. W. 2	29 18			6	Cloudy	N.b.E. 0	29 92	
4.	12	Cloudy		29 38		20.	12			29 92	
	9		S. 1	29 58			9	Cooler	N. 1	29 96	
	6	Cloudy		29 72			6	Cloudy	N. 0	30 00	
5.	12	Sultry	S.b.W. 1	29 83		21.	12	Much			
	9	Hot		29 85			9	cooler	N. E. 1	30 02	
	6	Thunder	E. by S.	29 85			6		N. 0	30 01	
6.	12	Rain	E. 0	29 82	1 13	22.	12	Fair	E. 1		
	9	Thunder		29 74			9		n.e.b.n.0	29 90	
	6	Fog	S. by W.	29 70	0 02		6	Cloudy	N. 0	29 80	
7.	12	Fair	S. W. 1	29 71		23.	12	Rain	E. 1	29 79	
	9	Hot	S.w.b.w.	29 72			9	Fair		29 79	
	6	Fair	S.w.b.w.	29 70			6	Great	n.e.b.e. 1	29 77	
8.	12					24.	12	Drought	E. 1	29 78	0 10
	9	Cloudy	S. 0	29 56			9			29 78	
	6		S.byE. 0	29 50			6	Cloudy	n.e.b.e. 0	29 74	
9.	12	Fair	S. 1	29 48		25.	12	Dry	N. E. 1	29 73	
	9	Rain	S. 0	29 51			9		E. 1	29 71	
	6		S.byE. 0	29 60			6	Sultry		29 71	
10.	12	Fair	S.b.W. 1	29 63	0 01	26.	12		E. 0	29 71	0 05
	9		S. 0	29 75			9	Day		29 73	
	6		S.	29 75			6	Miſt	E. 0	29 74	
11.	12	Fair	S.			27.	12	Rain	E. by S.	29 73	0 29
	9		E. 0	29 65			9	Thunder	S. 0	29 74	
	6	Cloudy	N. W. 1	29 60			6	Miſt		29 81	
12.	12	Fair	N.w.b.w	29 55		28.	12	Hot and	S. 1	29 83	
	9		N.W. 0	29 49			9	Dry		29 86	
	6		W. 0	29 40			6	Dry	E. 0	29 85	
13.	12	Fair	S. W. 0	29 34		29.	12	Burning	E. 1	29 85	
	9		S. W. 0	29 28			9	Day	S. 0	29 87	
	6	Fair					6	Fair	S. W. 0	29 88	0 97
14.	12				0 02	30.	12			29 88	
	9	Rain	E. 0	29 38			9	Rain	S. 1	29 08	0 31
	6	Miſty	E. 0	29 45							
15.	12	Fair									
	9	Hot	N.b w. 4	29 64							
	6			29 78						Total	4 91
16.	12	Cloudy	N. 1.		0 01						
	9			29 90							

JULY, 1697.

D.	h.	Weather.	Winds.	Barom.	Rain.
	6	Rain	S. S. W.	29 75	
1.	12		S. W. 1	29 72	
	9	Fair	S. W. 0	29 70	0 24
	6		S. W. 0	29 67	
2.	12	The ſame			
	9		S. W. 1	29 59	0 22
	6		W.b.n. 1	29 64	
3.	12	Fair		29 75	
	9		S. W. 0	29 84	
	6	Cloudy	S. 0	29 85	
4.	12	Fair	S. W. 1	29 85	
	9	Hot	S. W.	29 85	
	6	Fair	W. 0	29 87	
5.	12	Cool			
	9	Breezes	W. 1	29 99	
	6	Hot	W. 0	29 95	
6.	12	Dry	W.b.S. 1	29 94	
	9	Day		29 90	
	6	Fair	W.b.n. 0	29 86	
7.	12	Hot			
	9	Rain	W.b.S. 0	29 79	0 12
	6	Miſling	S. W. 1	29 68	
8.	12	Rain	S. W. 2	29 60	
	9	Cloudy	S.S.W. 1	29 44	0 32
	6	Rain	S. W. 1	29 42	0 75
9.	12	Cool	S. W. 1	29 43	
	9	Fairer	w.n.w. 0	29 47	0 77
	6	Fair	W.b.n. 0	29 58	
10.	12	and	W. 1	29 71	
	9	Cool	n.w.b.w.	29 83	
	6	Rain		29 85	
11.	12	Warmer	S. W. 1	29 85	
	9			29 93	0 50
	6		S.w. b.w.	30 00	
12.	12				
	9				
	6	Fair			
13.	12	and			
	9	Hot	S. 0	29 98	
	6	Fair	S. 0	29 90	
14.	12		S.b.W. 1	29 88	
	9	Cloudy	S. W. 1	29 84	
	6	Rain	N.b.w. 1	29 84	
15.	12	Cloudy	W. 1	29 85	0 48
	9	Fair	N. W. 0	29 90	
	6	Cooler	W. 1	29 95	
16.	12	Rain	n.w.b.w.	29 94	
	9	Thunder		29 92	0 42
	6	Fair	W.b.n. 0	29 91	
17.	12	and	N. 0	29 93	
	9	Cool	N.N.w 0	29 93	
	6	Fair	N.W. 1	29 95	
18.	12	Cloudy			
	9	Rain	N. 1	29 98	
	6	Miſling	N.	29 98	
19.	12		W.n.w. 1	30 02	0 62
	9	Cloudy			
	6				
20.	12	Showry.			
	9		W.b.S. 1	29 88	
	6	Rain	W.ſ.w. 1	29 75	
21.	12	Fair	W.b.n. 1	29 11	
	9	Miſling	W. 1	29 60	
	6	Miſty	S.w.b.w.	29 48	
22.	12	Rain			
	9	Fair	S.W.b.S.	29 50	0 43
	6	Fair	S.b.W. 0	29 50	
23.	12	Cool	S. 1	29 48	
	9	Day	S. 0	29 48	
	6	Fair Thun.	S. 1	29 50	
24.	12	great Sh.	W. & N.	29 56	
	9	with Hail.	& S.	29 60	1 02
	6	Fair	W. 0	29 65	
25.	12	Pleaſant	N. W. 1	29 72	
	9	Day	W.S.w. 0	29 77	
	6	Fair		29 76	
26.	12	Cloudy	W.b.S. 0	29 76	
	9	Miſling		29 69	
	6	Cloudy	S.b.W. 0	29 63	
27.	12	and	*S.e.ſ.b.w*	29 60	
	9	Cool	E.b.N. 1	29 60	
	6		N.N.e. 2	29 58	
28.	12	The ſame	E.b.N. 2	29 62	
	9			29 69	
	6	Fair	N. 1	29 70	
29.	12	Cool	N. 2	29 76	
	9	Day		29 90	
	6		N.b.w. 0	29 77	
30.	12	The ſame	W.b.n. 1	30 00	
	9			30 00	
	6	Cloudy	S.b.E. 1	29 90	0 20
31.	12	Warmer	S.S.E. 1	29 86	
	9	Rain	S. 1	29 79	
				Total	6 09

AUGUST, 1697.

D.	h.	Weather.	Winds.	Barom.	Rain.
1.	6	Cloudy	S.b.E. 1	29 73	
	12	Cloudy	S.b.E. 1	29 72	
	9	Rain	S.b.E. 2	29 65	
2.	6	Fair	S.b.E. 0	29 63	0 51
	12	Showers	W.b S. 1	29 65	
	9	Fair		29 68	0 40
3.	6	Rain	S.byE. 2	29 [illegible]9	
	12	Cloudy	W. 3	29 71	
	9	Fair		29 78	0 05
4.	6	Rain	S.w.b.ſ. 1	29 09	
	12		S.b.W. 2	29 65	
	9	Fairer	W. 1	29 60	1 00
5.	6	Rain			
	12		S. W. 2	29 50	
	9	Fairer	S. W. 1	29 49	0 79
6.	6	The	S.b.W. 0	29 47	
	12	ſame	S. 1	29 48	
	9			29 4[illegible]	0 22
7.	6	Cloudy	S.b.E. 0	29 51	
	12	Rain	E b.N. 1	29 55	
	9	Fairer	E.N.E. 1	29 58	0 07
8.	6		N. 2	29 50	
	12	Rain	N. 1	29 48	4 00
	9	both	N. 2	29 39	0 91
9.	6		W. 2	29 37	
	12	Days	W.b.S. 1	29 42	0 50
	9			29 4[illegible]	2 20
10.	6	Cloudy	W. 1	29 60	0 39
	12	Rain	N.W. 2	29 66	
	9	Fairer	N. 1	29 75	0 07
11.	6	Fair	W. 0	29 77	
	12	Pleaſant	W. 1	29 80	
	9	Day	W.n.w. 1	29 82	
12.	6	Cloudy	W.b.n. 0	29 82	
	12		W.b.n. 0	29 82	
	9	Fair	N. 0	29 85	
13.	6	Miſt	N. 0	29 88	
	12	Cloudy	W.b.S. 1	29 85	
	9	Rain	S.b.W. 1	29 83	0 33
14.	6	Cloudy	S. W. 2	29 73	
	12		W. 2	29 85	
	9	Fair	W. 2	29 86	
15.	6	Cloudy	S.W. 1	29 84	
	12	Little	W.b.S. 2	29 81	
	9	Rain	S.w.b.w. 1	29 75	
16.	6	Cloudy		29 70	
	12	Fair	S. 1	29 62	
	9	Cloudy		29 53	
17.	6		S. 0	29 48	
	12				
	9				
18.	6				
	12				
	9				
19.	6				
	12				
	9				
20.	6	Fair, great	S.b.W. 2		
	12	Storm Thunder			
	6	Rain.		29 60	1 88
21.	6	Cloudy		29 60	
	12	Rain	S. 1	29 60	
	9	Cloudy		29 61	0 13
22.	6	Cloudy	W.b:S. 0	29 74	
	12	Miſling	W. 1	29 84	
	9	Fair	W.	29 90	
23.	6	Fair	W.b.S. 0	29 92	
	12		W.b.S. 2	29 88	
	9	Cloudy	S. W. 2	29 84	
24.	6	Fair		29 82	
	12		S. W. 1		
	9	Sultry		29 78	
25.	6	Cloudy	S.w.b.ſ. 1	29 70	
	12		S.w.b.ſ. 2	29 67	
	9	Fair	S b.W. 2	29 54	
26.	6	Rain	S. 3	29 2[illegible]	
	12		W.b:S. 3	29 31	
	9	Fair		29 54	0 53
27.	6		S. W. 1	29 81	
	12	Fair	W.b.S. 2	29 93	
	9			29 98	
28.	6		S.S.W. 0	29 94	
	12	Fair	S.S.W. 2	29 94	
	9			29 90	
29.	6	Cloudy	S. W. 0	29 95	
	12	Sultry	E. 0	29 99	
	9	Very l.		30 03	
30.	6		N. E. 0	30 03	
	12	Fair			
	9				
31.	6	Fair			
	12	and			
	9	Sharp Air		30 01	
				Total	13 98

SEPTEMBER, 1697.

D.	h.	Weather.	Winds.	Barom.	Rain.
	6	Fair	E.b.N. 1	29 98	
1.	12		N. E. 2	30 00	
	9	Cool		30 98	
	6		N.e.N. 3	29 93	
2.	12	The	N. E. 2	29 92	
	9	ſame		29 90	
	6	Hot Sun	E.byN. 0	29 88	
3.	12	but	E. 1	29 89	
	9	Cool Air	E.	29 89	
	6	Fair	E. 0	29 84	
4.	12	Warmer	E. 2	29 84	
	9	Air		29 80	
	6	Fair	E. 1	29 78	
5.	12		E. 0	29 80	
	9	Hot		29 83	
	6	Miſt	E. 0	29 83	
6.	12	Fair	S.b.E. 0	29 86	
	9	Hot		29 87	
	6		S. 0	29 85	
7.	12	The	E. 2	29 83	
	9	ſame	E. 0	29 80	
	6		E. 0	29 73	
8.	12	The			
	9	ſame		29 70	
	6	Fair	E.b N. 1	29 68	
9.	12		E.b.N. 2	29 66	
	9	Cooler		29 56	
	6	Cloudy	E. 1	29 43	
10.	12		S. 2	29 39	
	9	Rain		29 40	0 10
	6		S.b.E. 0	29 38	
11.	12	Showers	W.S.w. 1	29 40	
	9			29 60	1 59
	6	Fair	S. 0	29 76	0 07
12.	12		S.b.w. 2	29 77	
	9	Cloudy		29 70	
	6	Rain	S. 2	29 49	
13.	12		S. 3	29 38	
	9	Fair		29 63	1 54
	6		S. 0	29 67	
14.	12	Rain	S. 2	29 50	
	9		S. 4	29 32	3
	6	Fair	S. W. 1	29 46	
15.	12			29 30	
	9	Rain	3	29 30	
	6	Fair	S. W. 4	29 28	
16.	12	Cool	W.b.S. 6	29 32	
	9	Cloudy	2	29 34	
	6	Fair	W. 1	29 45	
17.	12	Cool			
	9		0	29 75	
	6		E.byS. 0	29 55	
18.	12	Rain	S.S.W. 2	29 34	3 10
	9		S. W. 2	29 10	1 60
	6	Fair	W.b.n. 0	29 38	
19.	12	Cloudy	S. W. 1	29 50	
	9	Rain	S. 1	29 32	0 56
	6	Rain	S. W. 3	29 05	
20.	12		W.ſ.w. 3	29 02	
	9	Fair	3	29 21	0 14
	6	Cloudy	W ſ.w. 3	29 35	
21.	12	Rain	S. 1	29 31	
	9	Cold	S. W. 1	29 98	
	6	Fair	S. W. 2	29 24	
22.	12	Shower			
	9			29 38	0 09
	6	Fair	S. W. 1	29 51	
23.	12				
	9	Rain	W.N.w.	29 74	
	6		S. W. 0	29 87	
24.	12	Fair	N.		
	9	Rain		29 87	
	6		E. 0	29 66	0 98
25.	12	Cloudy	S. E. 2		
	9	Miſling		29 38	0 30
	6	Fair	N. E. 0	29 38	
26.	12	Rain	E. 1	29 40	
	9	Cold		29 30	0 24
	6	Fair	E. 0	29 27	
27.	12	Cloudy	E.byN. 1	29 25	
	9	Rain		29 30	0 84
	6	Fair	N. E. 1	29 38	
28.	12	Cold	N.byE 3		
	9	Day		29 56	
	6	Hoar-Fro.	N.byw. 1	29 65	
29.	12		N.byw. 1	29 70	
	9	Fair		29 78	
	6	Ice	N.byw. 0	29 80	
30.	12	Fair		29 82	
	9	Cloudy		29 83	0 22
				Total	10 47

OCTOBER, 1697.

D.	h.	Weather.	Winds.	Barom.	Rain.	D.	h.	Weather.	Winds.	Barom.	Rain.
	7	Cloudy	N. W. 0	29 79			7		N.b.w. 0	30 27	
1.	12	Miſty	S. 1			17.	12	Same	N.b.E. 1	30 30	
	9	Warm	S. 0	29 78			9			30 34	
	7	Rain	S. 0	29 77	0 10		7	Cloudy	N.byE. 0	30 32	
2.	12	Cloudy	S.b.E. 0	29 75		18.	12	Fair		30 33	
	9	Warm		29 70			9	Colder	E.byS. 0	30 27	
	7	Cloudy	S.b.E. 0	29 51			7	Hoar-Fro.	S. W. 0	30 22	
3.	12		S. 1	29 40		19.	12	Miſt	N.byE. 0	30 28	
	9	Rain		29 31	0 72		9	Fair		30 30	
	7	Fair	S.w.bw. 1	29 50			7	Fog-Fr.	N. W.	30 28	
4.	12	Cold	S. W. 2	29 52		20.	12	Cool	S. W.	30 26	
	9	Rain		29 28			9			30 23	
	7		S. 4	29 00	1 12		7	Cloudy	W.S.w. 1	30 15	
5.	12	Rain	S.b.w. 2	28 98		21.	12		W.b.S. 1	30 16	
	9			29 13	0 57		9	Fair		30 20	
	7	Rain	S. 1	29 16			7		W.b.S. 0	30 25	
6.	12	Stormy	E. & W.	29 97		22.	12	Fog	S. W. 0	30 25	
	9	Fairer	S. & 6	29 28	1 36		9			30 25	
	7	Rain	S.b.E. 1	29 08			7	Cloudy	S. S. W.	30 22	
7.	12		N. 1	29 13		23.	12	Fair			
	9	Fair	W. 1	29 58	2 52		9	Cloudy		30 15	
	7	Rain	S. 2	29 66			7	Cloudy	S. W. 0	30 06	
8.	12	Cloudy	S. W. 4	29 64	0 10	24.	12	and			
	9	Stormy	5	29 44			9	Warm		29 94	
	7	Stormy	S. W. 8	29 39			7		S. W. 2	29 80	
9.	12	Cloudy	W.ſ.w. 4	29 51		25.	12	Same	W.S.w. 2	29 78	
	9	Fairer Fair	2	29 66			9			29 74	
	7	Fair	S.w.bw. 0	29 88			7	Cloudy	S. W. 2	29 60	
10.	12	and	W.b.S. 0	30 00		26.	12	Warm	S. W. 6	29 52	
	9	Pleaſant		30 15			9	Rain		29 27	
	7	Froſt	W.b.S. 0	30 20			7	Fair	S. W. 2	29 37	1 52
11.	12	and		30 21		27.	12	Rain	S.w.bw 5	29 34	
	9	Miſty	S. W. 0	30 18			9	Stormy	0	29 88	0 21
	7	Froſt	S.w.bw 0	30 17			7	Froſt	S. W. 0	30 08	
12.	12					28.	12	Fair			
	9	Fair					9	Rain		29 89	
	7						7	Warm	S. W. 4	29 78	
13.	12	Fair				29.	12	Small			0 02
	9		W. 1	30 20			9	Showers	3	29 74	
	7	Fair	W.b.S. 0	30 18			7	Cloudy	W byS. 5	29 48	
14.	12	and	W.n.w. 0	30 18		30.	12		W. 6	29 54	
	9	Warm		30 16			9	Fair		29 75	
	7	Cloudy	W.b.S. 0	30 12			7	Fair	N. 0	30 04	0 01
15.	12	Warm	N. W. 0	30 12		31.	12	and	N. E. 2	30 17	
	9	Miſling		30 16			9	Cool		30 26	
	7	Cloudy	W. 0	30 06						Total	8 39
16.	12	Fair	N.n.w. 2	30 08	0 14						
	9	Cold	N.byW.	30 20							

NOVEMBER, 1697.

D.	h.	Weather.	Winds.	Barom.		Rain.	
1.	8	Miſling	S. 1	30	19		
	12						
	9	Miſty		30	15		
2.	8	Fair	S.S.W. 0	30	11		
	12	Warm	W.b.S. 0	30	11		
	9	Pleaſant		30	07		
3.	8	Fair	W. 0	30	04		
	12	Colder	W.b.S. 0	30	02		
	9	Fog		29	99		
4.	8	Cloudy	S.w.b ſ. 0	29	94		
	12	Cold		29	88		
	9	Day		29	81		
5.	8	Rain	S. W. 2	29	73	0	50
	12	Fair	W.b.S. 2	29	75		
	9			29	81		
6.	8	Rain	W.b n. 1	29	87		
	12	Fair					
	9	Cold		30	00		
7.	8	Cold	E. 0	29	93		
	12	Cloudy	E.S.E. 0	29	91		
	9	Day		29	92		
8.	8	Froſt	E.byS. 0	29	96		
	12		E.S.E. 0	29	99		
	9	Fair					
9.	8	Hard		30	10		
	12	Froſt	E. 0	30	10		
	9	Fair		30	10		
10.	8	Cloudy	N. E. 0	30	08		
	12	Froſt					
	9	Fair		30	04		
11.	8	Rain	W.b.S. 1	29	73		
	12		N. 2				
	9	Fairer		29	72	0	78
12.	8	Rain	N.b.w. 2	29	70	0	02
	12	Fair	N. 1		68		
	9	Froſt			65	0	15
13.	8	Rain	N. 1	29	63		
	12	Cloudy		29	62	0	09
	9	Froſt		29	56		
14.	9	Snow	N. E. 2	29	40	0	82
	12	Sleet all	N. 1	29	38		
	9	Day		29	48	0	50
15.	8	Froſt	W.b.S. 0	29	64		
	12						
	9						
16.	8	Hard					
	12	Froſt	N.b.w. 2				
	9	Fair		29	04		
17.	8		N.b.w. 2	30	03		
	12	Same	N.b.w. 3	30	03		
	9			30	02		
18.	8		N.n.w. 1	29	92		
	12	Same	N.n.w. 0	29	91		
	9			29	76		
19.	8	Snow	S.S.w. 2	29	26		
	12	Sleet					
	9	Rain		28	83	1	20
20.	8	Cloudy	N.b.w. 2		82		
	12	Sleet	N b.w. 3		82		
	9	Cold		30	93	0	01
21.	8	Cloudy	N. W. 2	28	93		
	12			28			
	9	Snow	W.b.n. 1	28	90	0	18
22.	8	Froſt	N. 0	28	95		
	12	Fair	N. 1	28	98		
	9	Sleet		28	09	0	09
23.	8	Froſt	N. W. 2	29	11		
	12	Fair				0	13
	9						
24.	8	Snow					
	12	Fair					
	9			29	36		
25.	8	Hard	S. 0	29	36		
	12	Froſt	S. 1	29	37		
	9	dripping		29	35		
26.	8	Rain	S e.b.S. 2	29	21	0	01
	12	Fairer	S. E. 2	29	08		
	9	Rain		29	00	0	33
27.	8	Fair	S.b.W. 0	29	11	0	20
	12	Thaw	S. 1	29	18		
	9	Rain		29	00		
28.	8	Cloudy	S. 0			0	41
	12	Warmer					
	9	Rain		29	10		
29.	8	Froſt	S.S.w. 0	29	15	0	18
	12	Fair.		29	19		
	9			29	19		
30.	8	Small Fr.	W. 1	29	40		
	12	and	W.b.n. 1	29	54		
	9	Fair		29	77	0	03
				Total		5	63

DECEMBER, 1697.

D.	h.	Weather.	Winds.	Barom.		Rain.		D.	h.	Weather.	Winds.	Barom.		Rain.	
	8	Hard	W.b.n. 0	29	86				8	Froſt		29	57		
1.	12	Froſt &	W.b.n. 2	29	87			17.	12	Cloudy	E. 0	29	56		
	9	Fair		29	89				9	Fairer		29	62		
	8		N. 1	29	90				8			29	64		
2.	12	Same	N. 0	29	94			18.	12	Miſt	E. 0				
	9			29	99				9			29	72		
	8		N. 0	30	05				8	Cloudy		29	70		
3.	12	Same	N.N.E. 0	30	08			19.	12	Warm	E. 1	29	68		
	9			30	06				9	Day		29	63		
	8	Cloudy	N.W. 1	29	90				8	Fog	E. 2	29	50		
4.	12	Snow	W.n.w 1	29	89			20.	12	Cloudy					
	9	half Inch		29	96				9	Colder		29	44		
	8	Cloudy	N.b.E. 2	30	00				8	Rain		29	45	0	23
5.	12	Fair	N.N.E. 1	30	06			21.	12	Cloudy	E. 1	29	51		
	9			30	09				9	Cold		29	62	0	17
	8	Snow	N.w.b.n. 3	29	98				8	Rain		29	75	0	02
6.	12	Fair	N.w.b.n. 1	29	99			22.	12	Cloudy	E. 1				
	9	Sn. 1 inch		29	00				9	Fair		29	90		
	8	Snow 6	N. W. 0	29	93				8		S.by E. 1	29	83		
7.	12	Snow 8	S. 0	29	71			23.	12	Cloudy	S. 1	29	76		
	9	Inches		29	68				9			29	64		
	8			29	84				8		S.by W. 2	29	52	0	40
8.	12	Fair	E. 0	29	87			24.	12	Rain	S. 2	29	46		
	9			29	85				9	Stormy	2	29	34	0	56
	8	Snow		29	64				8	Fair	W. 3	29	25		
9.	12	Sleet	S.by E. 1	29	55			25.	12	and	S. W. 2	29	40		
	9	Thaw		29	42				9	Warm		29	61	0	03
	8	Froſt	E.N.E. 0	29	55				8	Cloudy	W.S.w. 2	29	62		
10.	12	Thaw	E. 0	29	57	3	62	26.	12	Fair	W.b.S. 2	29	70		
	9	Snow	2	29	46				9	Warm	3	29	87		
	8	Rain	E.S.E. 2	29	09	2	76		8	Cloudy	W.S.w. 2	29	90		
11.	12	Warm	S.b.W. 1	29	10			27.	12						
	9	Thaw		29	24	0	90		9	Miſling		29	82		
	8	Thaw	S.by E. 2	29	14				8	Cloudy	S.by W. 0	29	66		
12.	12		S. 2	29	04			28.	12	Rain	W.b.S. 3	29	56		
	9	Rain		29	11	0	42		9	Fair		29	75	0	08
	8	Fair	S. W. 3	29	33				8	Fair	W. 2	29	90		
13.	12	Warm	W.S.w. 3	29	50			29.	12	Cloudy	W.b.n. 2	29	97		
	9	Pleaſant	S. W. 1	29	61				9	Rain	2	29	97		
	8	Cloudy	S. W. 1	29	68				8	Fair	N. E. 1	30	10	0	05
14.	12	Warm	W.S.w. 1	29	57			30.	12	Cloudy	N. E. 1	30	15		
	9	Day	W.S.w. 0	29	65				9	Fair		30	20		
	8	Miſty	E. 1	29	64				8	Froſt	E. 0	30	18	0	01
15.	12	Warm	N.by E. 0	29	64			31.	12	Cloudy	E.by S. 0	30	15		
	9	Day		29	65				9	Fair		30	08		
	8	Froſt										Total		9	31
16.	12		E.b.N. 1	29	58										
	9	Fair		29	59										

In this Table, the Quantity of Rain, which fell through a Tunnel of twelve Inches Diameter, is ſet down in Pounds and Centeſimals; and I meaſured it with a Cylindrical Glaſs, after Mr. *Townley*'s Method.

Where only one ſort of Weather is noted upon one Day, that was the Weather of all the Day; eſpecially if the Barometer be noted three times. The ſame obſerve alſo in the Column of Winds.

In the Column of Winds, 0 ſignifies a Calm; 1, 2, 3, *&c.* denotes the Strength of the Wind: wherefore 5, or 6, is a little Storm; 7, or 8, a great Storm.

I have noted in the Column of Weather, the Depth of the Snow upon the Ground.

The whole Quantity of Rain that fell through my Tunnel laſt Year, was 77,60 *l.* which is leſs than fell from the Beginning of *March* (at which time I began my Rain Obſervations) till the End of *December*, 1696. In which ten Months there fell here, at *Upminſter*, almoſt 115 *l.* and at *Townley* in *Lancaſhire* (according to Mr. *Townley*'s Obſervations) above 172 *l.* and in the whole Year at *Townley* 203,76 *l.*

The Weather 1698, at Upminſter; *by Mr.* Will. Derham, n. 249. p. 45.

XXIV. The Quantity of Rain which fell through my Tunnel this Year, 1698, was 122,32 Pounds. I find foggy Weather makes the *Mercury* riſe, as well as the North Wind; as may be obſerved in the following Table, in the Month of *December*, at which Time the Mercury was very high, although the Wind was in the Southerly Points. I ſubmit it, whether the Cauſe be not the Increaſe of the Weight of the Atmoſphere, by an Addition of thoſe Vapours of which the Fog conſiſts, which are manifeſtly as heavy as the Air, becauſe they ſwim in it without aſcending. Theſe filling up many of the Vacuities of the Air, without extruding much the Parts of Air (as I judge Clouds do) do add conſiderably to the Weight of the Atmoſphere, and ſo cauſe the Mercury to aſcend.

The greateſt Range I have ever obſerved the Mercury to have, is no more than 2,12 Inches; it being here never higher than 30,40 nor lower than 28,28 Inches. The loweſt it ever was, within my Obſervations, was *Jan.* 24, about two of the Clock in the Afternoon; about which Hour Mr. *Townley* obſerved his Barometer to fall to 27,80 Inches, which, he ſays, was remarkably low.

JANUARY, 1698.

D.	h.	Weather.	Winds.	Barom.	Rain:	D.	h.	Weather.	Winds.	Barom.	Rain.
1.	8	Froſt	S. E. 0	29 95		17.	8	Sn. with	N. W. 0	29 57	
	12	Fair	S.by E. 1	29 90			12	the former	E.1.n e. 2	29 60	
	9	Hard Fr.	0	29 82			9	5 Inches	N.by E. 1	29 65	
2.	8	Cloudy	S.by E. 1	29 03		18.	8	Little	N. 1	29 68	
	12	Froſt	S.by E. 2	29 48			12	Snow very	N. 2	29 69	
	9	Snow	0	29 26			9	Cold	N.by E. 2	29 71	
3.	8	Snow	W.by S. 0	29 15		19.	8	Sn. 3 Inc.	E. 0	29 62	
	12	1 Inch.					12	more, Clo.	E.by S. 2	29 59	
	9	Rain		28 94	0 55		9	all Day	2	29 59	
4.	8	Rain, Sleet	E. 0	28 80	0 99	20.	8	Cloudy	E.by N. 3	29 65	
	12	Sn. 4 Inch.	E. 0	28 88			12	very cold	E.by N. 3	29 70	
	9	Cloudy		29 18	2 98		9	Day	2	29 84	
5.	8	Froſt	W. 0	29 44	0 20	21.	8	Hard-Fro.	E.by N. 2	29 92	
	12	Fair	W.S.w. 1	29 53			12	and Cloud.	E.by N. 2	29 95	
	9	Cloudy		29 64	0 33		9	as before	1	29 95	
6.	8	Rain	E. 1	29 49	0 20	22.	8	Fairer	E.by S. 0	29 82	
	12	Fair	E by N. 1	29 5			12	very	E. 1	29 68	
	9	Cloudy		29 78	0 23		9	Cold	E. 3	29 30	
7.	8	Froſt	N.b.W. 1	29 98		23.	8	Sn. 5 Inch.	E.by N. 0	29 00	
	12	Fair	N. 1	30 04			12	Cloudy	N. E. 1	29 00	
	9	Showers		30 14			9	Snow. Day		29 07	
8.	8	Froſt	N.by E. 1	30 18		24.	8	Sn. 3 Inch.	E.b.S. 1	28 73 28 38	
	12	Showers of	N.N.E. 2	30 18			12	Sleet	S. E. 2	28 28	
	9	Snow		30 16			9	Thaw	S. W. 1	28 31	2 07
9.	8	Cloudy	N. E. 2	30 07		25.	8	Thaw	S. 2	28 38	0 3
	12	Cold	N.e.bn. 2	30 04			12	Showers of	S. 1	28 40	
	9	Day		30 00			9	Rain		28 56	0 3
10.	8	Froſt	N. E. 1	29 90		26.	8	Rain	S. 0	28 72	0 2
	12	Cloudy		29 89			12	Thawwith			
	9	Day					9	Showers		28 94	0 0
11.	8	Same	N. E. 0			27.	8	Fairer	S.by W. 0	29 03	0 0
	12	but leſs		29 79			12		S.b.E. 1	29 00	
	9	Cold		29 73			9	Rain		28 8	0 3
12.	8	Cloudy	N. E. 0	29 61		28.	8	Froſt and	W.b.S. 0	28 98	0 1
	12	Fairer	S.b.W. 1	29 53			12	Fair	S.S W. 1	28 88	
	9	Fair		29 3			9	Rain	S.e.b.ſ. 1	28 68	0 2
13.	8	Froſt	S. 0	29 21		29.	8	Same	S. W. 2	28 90	
	12	Fair		29 18			12	with Bluſt.	S.S.E. 4	28 67	
	9	Snow	W. 0	29 1			9	Snow	4	28 53	0 7
14.	8	Sn. 3 Inch.	N.n.w. 1	29 23		30.	8	Froſt	W.b.S. 1	28 92	0 4
	12	Cloudy	N.n.w. 1	29 29			12	Fair, plea-	W. 2	29 06	
	9	Fair	N. 1	29 40			9	ſant Day		29 51	
15.	8	Hard	N.bW. 1	29 52		31.	8	Fair	N. W. 0	29 70	0 3
	12	Froſt	N. 1	29 65			12	Wet Af-	S. W. 1	29 71	
	9	Fair	N. 0	29 79			9	ternoon		29 58	
16.	8		N.b.W. 0	29 77						Total	10 9
	12	Same									
	9		N. 0	29 74							

FEBRUARY, 1698.

D.	h.	*Weather.*	*Winds.*	*Barom.*	*Rain.*
1.	7	Miſling	S. W. 2	29 48	
	12				
	9	Warm			
2.	7	Fair			
	12				
	9	Miſling	4	29 11	
3.	7	Fair	W.byS.3	28 97	0 34
	12	Cloudy	W.S.w.4	29 06	
	9	Fair	1	29 26	
4.	7	Froſt	S. W. 0	29 36	
	12	Fair and	W. 1	29 42	
	9	Pleaſant		29 63	
5.	7		N. 1	29 86	
	12	The ſame	N. E. 1		
	9			30 06	
6.	7	Froſt	E.b.N. 1	30 08	
	12	and	E. 1	30 08	
	9	Cloudy			
7.	7	Froſt	E b.N. 0	30 01	
	12	Fair	W. 1	30 01	
	9	Warm		29 96	
8.	7	Froſt	E. b.N. 0	29 88	
	12	Fair and	E. 0	29 89	
	9	Cooler		29 89	
9.	7		E.byN.0	29 83	
	12	Same	E.N.E.1	29 84	
	9		0	29 91	
10.	7	Cloudy	N. E. 1	29 99	
	12	Cold	N. E. 2	30 02	
	9	Fair		30 07	
11.	7	Froſt	N. E. 1	30 08	
	12	and	E.byN.2	08	
	9	Fair	N. E. 1	30 11	
12.	7	Fair Cl.	E.N.E.1	29 90	
	12	with	N. E. 2	29 87	
	9	Froſt	2	29 85	
13.	7	Froſt Cl.	E.N.E.3	29 84	
	12	and very	N. E. 4	29 86	
	9	Cold	N. E. 3	29 94	
14.	7		N.b.w.0	29 83	
	12	Snow	n.w.bn.2	29 86	
	9		4	29 86	
15.	7	Snow half	N. E. 3	29 86	
	12	inch, very	N.e.bn.4	29 81	
	9	Cold	2	29 72	
16.	7	Snow one	N.e.be.	29 63	
	12	inch, very	E.N.E.3	29 50	
	9	Cold		29 53	
17.	7	Cloudy	E.byN.2	29 42	
	12	Sleet, leſs	E.byN.1	29 38	
	9	Cold		29 43	
18.	7	Fairer Cl.	E. 0	29 46	0 14
	12	Thaw	E.byN.1	29 50	
	9	Rain		29 52	0 16
19.	7	Cloudy	E. 2	29 51	0 15
	12	Rain	E.byN.2	29 55	
	9	Cloudy		29 68	0 28
20.	7	Fairer	E.byN.2	29 68	
	12	Colder	E.byN.3	29 71	
	9	Freezing		29 75	
21.	7	Froſt	E.byN.1	29 81	
	12	Fair and	E.byN.2	29 84	
	9	Pleaſant	0	29 84	
22.	7		N. E. 0	29 85	
	12	Same	E.byN.1	29 88	
	9			29 90	
23.	7	Froſt and	E.byN.0	29 94	
	12	Fair	E. 1	29 97	
	9	Cl. warm		30 00	
24.	7	Cloudy	E. 0	29 96	
	12	Froſt Cold	E. 1	29 97	
	9	Fair		29 97	
25.	7	Miſt Froſt	E.byN.0	29 95	
	12	Fair and	E. 0	29 95	
	9	Warmer		29 93	
26.	7	Froſt	E. 0	29 88	
	12		E. 1	29 88	
	9	Cloudy		29 88	
27.	7	Fr. & Fair	E. 0	29 79	
	12	Warmer	E. 1	29 78	
	9	Cloudy	S. W.	29 70	
28.	7	Rain	S.w.bſ. 1	29 00	0 24
	12	Fair and			
	9	Thaw			
				Total	1 31

MARCH, 1698

D.	h.	Weather.	Winds.	Barom.	Rain.	D.	h.	Weather.	Winds.	Barom.	Rain.
	6	Fair					6		S. 1	29 80	
1.	12	warm and				17.	12	Same	S. W. 2	29 68	
	9	Pleaſant		29 60			9	Rain	S.b W. 3	29 43	
	6	Fair	S.S.E. 0	29 39				Fairer	W.b.S. 4	29 24	0 23
2.	12	Warm	S.b.w. 1	29 38		18.	12	Hail and	W.b.S. 7	29 3	
	9	Rain	n.w.bw.1	29 60	0 32		9	Cooler	1	29 50	0 09
	6		N. W. 1	29 74			6	Hoar-Fr.	S. W. 0	29 60	
3.	12	Cloudy	N. 2			19.	12	Fair	W. 2	29 74	
	9			30 00			9	Rain	0	29 78	
	6	Cloudy	N. 1	30 05			6	Cloudy	w.ſ.bw.2	29 76	0 01
4.	12	Colder	N.b.E. 2	30 10		20.	12		S. W. 3	29 78	
	9	Day		30 19			9	Warmer		29 78	
	6	Cloudy	N. E. 1	30 16			6		S.S.W. 2	29 68	
5.	12	Cold	E.byN. 2	30 10		21.	12	Same	S. W. 3		
	9	Winds		30 05			9			29 58	
	6	Froſt	N. E. 0	29 92			6	Cloudy	S. S.W. 1	29 59	
6.	12		N. E. 1	29 90		22.	12		W. 1	29 73	
	9	Fair.		29 83			9	Fair	N. W. 0	29 98	
	6	Froſt	N. E. 2	29 72			6	Froſt	N.b.w. 0	30 11	
7.	12	Cloudy	N.e.b.e 3	29 74		23.	12	Fair and	S. 1	30 14	
	9	Cold		29 74			9	Pleaſant	S. W. 0	30 14	
	6	Froſt	N. E. 0	29 70			6		S.b.E. 0	30 09	
8.	12	Cloudy	N.e.b.e.1	29 71		24.	12	Same	E.byS. 1	30 08	
	9	Warmer		29 80			9			30 00	
	6	fr. fair & ſhp	S.e.b.e.0	29 81			6	Froſt	E.byN.0	29 90	
9.	12	Snow	S. 1	29 76		25.	12	Fair	E. 1	29 88	
	9	Rain		29 68			9	Fair		29 83	
	6	Cloudy	S. 0	29 51	1 49		6	Fair very	E. 0	29 77	0 38
10.	12	Showers	W. 2	29 54		26.	12	Warm	E. b. S. 1	29 77	
	9	Fair		29 71	0 10		9	Lightning		29 71	
	6	Showers	S. 1	29 63			6	Miſty	S. W. 0	29 73	
11.	12		S.S.W. 2	29 42		27.	12	Fair	S. 1	29 75	
	9	Fairer	S. W. 2	29 61	0 70		9	Cloudy		29 66	
	6	Rain	S.S.W. 3	29 42	0 26		6	Rain	S. 2	29 42	0 28
12.	12	Warm	S. W. 5	29 35		28.	12	Cloudy	S.b.W. 4	29 34	
	9	Showers	S. W. 3	29 39	0 98		9	Cooler		29 46	0 05
	6		S.w.bw 2	29 63			6	Fair	W.S.w.1	29 63	
13.	12	Fair	S.w.bw 2	29 69		29.	12		W.b.S. 2	29 70	
	9		W.S.w.2	29 78			9	Showers		29 79	0 06
	6	Warm	S.w.bw 2	29 74			6	Hoar	S. 0	29 70	
14.	12	Cloudy	S.w.bw 4	29 74		30.	12	Froſt	S. W. 3	29 59	
	9	Day		29 84			9	Rain		29 46	0 34
	6		S. W. 2	29 87			6	Rain	E.byN.0	29 3	2 52
15.	12	Same	S. W. 3	29 89		31.	12	Rain	N. 2	29 49	1 52
	9		W.byS. 2	29 95			9	Fairer		29 72	9 33
	6		W.S.w.2	30 02						Total	9 33
16.	12	Same									
	9			30 03							

APRIL, 1698.

D.	h.	Weather.	Winds.	Barom.	Rain.	D.	h.	Weather.	Winds.	Barom.	Rain.
1.	6		S.byE. 0	29 68		17.	6	Fair	N.b.w. 2	29 87	
	12	Rain	S.S.W. 1	29 48			12	and	N. 2	29 88	
	9			29 26	1 47		9	Cold	N.b.E. 1	29 92	
2.	6	Cloudy	W.S.w. 2	29 27	0 11	18.	6		N.b.w. 1	29 90	
	12		W.n.w. 3	29 40			12				
	9	Fair		29 57			9				
3.	6	Hoar-Fr.	S. W. 0	29 62		19.	6	Cloudy			
	12	Fair	W. 1	29 71			12	Warm	N. 1	29 88	
	9	Rain		29 83	0 26		9	Rain		29 90	
4.	6		E.b.N. 0	29 90	0 03	20.	6	Cloudy	W. 1	29 80	
	12	Fair	N. E. 1	29 95			12	Rain	W.S.w. 2	29 68	0 44
	9			30 00			9			29 42	
5.	6		N.N.E. 1	29 97		21.	6	Fair and	W. 2	29 28	0 37
	12	Same					12	Cold	W.b.n. 2	29 30	
	9						9	Cloudy		29 26	
5.	6					22.	6	Rain	N. 3	29 34	0 19
	12	Cloudy					12	Snow	N.n.w. 3	29 43	
	9			29 88			9	Fair		29 44	0 3
7.	6	Fair	N.N.E. 0	29 94		23.	6	Ice, very	E.S.E. 1	29 32	
	12		E. 2	29 91			12	Cold	S. E. 2	29 29	
	9	Cloudy		29 79			9	Rain		29 28	0 58
8.	6		S.b.W. 2	29 65		24.	6	Miſling	E.b.S. 0	29 31	
	12	Showers	N. W. 2	29 71			12	Warmer	E. 1	29 46	
	9			29 83	0 22		9	Fair		29 68	
9.	6	Hoar-Fr.	S. W. 0	29 83		25.	6	Showers	S. W. 1	29 70	
	12	Cloudy	S. W. 2	29 82			12		W. 2		
	9	Fair	S. 0	29 82			9	Fair		29 83	0 42
10.	6		S.b.W. 2	29 75		26.	6	Fair	W. 2	29 83	
	12	Cloudy	S.S.w. 2	29 67			12	Hail	W. 3	29 80	
	9			29 64			9	Showers		29 63	
11.	6	Fair	S. W. 1	29 66		27.	6	Snow	W.b.S. 2	29 56	0 89
	12	with					12	Sleet	W. 3	29 56	
	9	Showers	W.b.S. 2	29 56	0 11		9	Fairer		29 62	0 48
12.	6	Fair and	W.b.S. 1	29 60		28.	6	Showers	N. W. 1	29 67	0 20
	12	Cool		29 68			12	of Hail	N.b.w. 2	29 73	
	9		S. 0	29 70			9	and Rain		29 83	0 31
13.	6	Cloudy	S. 1	29 68		29.	6	Cold	n.w.bn. 1	29 84	
	12	Warm	S.S.W. 1	29 66			12	Showers	N. W. 2	29 86	
	9	Rain	W.b.S. 0	29 62			9			29 81	0 43
14.	6		W.b.n. 1	29 68	0 14	30.	6		N.n.w. 1	29 78	0 09
	12	Fair					12	Rain	N.n.E. 2	29 78	
	9	Showers		29 80	0 06		9			29 80	0 25
15.	6	Cloudy	W.b.S. 2	29 50						Total	8 08
	12		N.n.w. 4	29 50							
	9	Showers	N.n.w. 3	29 73							
16.	6	Snow	N. W. 3	29 76							
	12		N. 5	29 85							
	9	Cloudy	N. 2	29 89	1 00						

MAY, 1698.

D.	h.	Weather.	Winds.	Barom.	Rain.
	6		S. 1	29 74	0 58
1.	12	Rain	N. W. 1	29 73	
	9			29 75	0 73
	6		N. 2	29 72	0 46
2.	12	Fair	W.n.w. 1	29 75	
	9			29 72	
	6	Fair	N. 0	29 75	
3.	12	Snow			
	9	Ice			
	6	Fair			
4.	12	Cold	N.byE. 2		
	9	Cloudy		29 71	0 22
	6	Cold	W. 0	29 72	
5.	12	and	S W. 1	29 71	
	9	Fair	S.byW. 2	29 70	
	6	Rain	S. W. 1	29 66	
6.	12	Warm			
	9	Fair	S.byE. 1	29 78	0 76
	6	Cloudy	S.byE. 1	29 78	0 13
7.	12		S.byE. 1	29 80	
	9	Fair	S. S. E. 0	29 80	
	6	Fair	N.byw. 1	29 80	
8.	12	Warm	N.n.w. 2	29 94	
	9	Day	N. 0	30 10	
	6		N.byw. 1	30 11	
9.	12	Same	W.b.S. 1	30 11	
	9			30 00	
	6	Small	W.byn. 0	29 82	
10.	12	Showers	N. W. 2	29 80	
	9		W.byn. 3	29 81	0 08
	6	Cloudy	N.n.w. 3	29 82	0 03
11.	12	Cooler	N.n.w. 2	29 85	
	9	Rain	N.N.E. 0	29 82	
	6		N. E. 2	29 69	0 51
12.	12	Showers			
	9		N.n.w. 2	29 68	0 10
	6	Cloudy	n.w.bn. 2	29 70	
13.	12		N. 3	29 70	
	9	Fair	N. 0	29 74	
	6		N. 0	29 75	
14.	12	Fair	E. 2	29 82	
	9			29 87	
	6		N. E. 1	29 92	
15.	12	Fair	N.byE. 1	29 95	
	9		E.byS. 0	29 94	
	6	Fair	E. 0	29 87	
16.	12	and			
	9	Warm	E. 0	29 73	
	6		E. 0	29 66	
17.	12	Rain			
	9		E. 0	29 63	0 54
	6	Rain	n.e.b.e. 0	29 59	0 43
18.	12	Warm	S. E. 1	29 56	
	9	Fair	S.S.E. 0	29 53	0 05
	6	Cloudy	E. 1	29 48	
19.	12	Hot	E.byE. 2	29 46	
	9	Fair	S. 0	29 49	
	6	Cloudy	S.e.bye. 1	29 49	
20.	12	Cooler	S. 4	29 50	
	9	Fair	S.byW. 2	29 62	
	6	Showers	S.S.W. 3	29 68	
21.	12		ſ.w.bw. 5	29 73	
	9	Fair		29 81	0 32
	6	Showers	S.byE. 1	29 72	0 02
22.	12	and	E.S.E. 1	29 70	
	9	Cooler	ſ.w.b.ſ. 3	29 66	0 95
	6	Rain	S.byE. 1	29 48	0 79
23.	12	Cloudy	S.byw. 2	29 47	
	9	Fair	S.byw. 0	29 46	
	6		S. 2	29 43	
24.	12	Showers			
	9		S. W. 0	29 46	0 49
	6				
25.	12	Fair			
	9				
	6	Rain			
26.	12				
	9	Cool	N.n.E. 2	29 53	2 73
	6	Cloudy	E.byS. 1	29 07	0 23
27.	12	Warm	S. 1	29 71	
	9	Fair	E. 0	29 78	
	6	Fair	N. 1	29 78	
28.	12	Showers	E.byN. 1	29 77	
	9	Rain	E. 1	29 76	0 02
	6		N.byE. 1	29 69	1 60
29.	12	Miſling	E.byS. 0	29 74	
	9		S. 1	29 76	0 22
	6		S.byW. 1	29 76	
30.	12	Fair			
	9		N.b.w. 1	29 70	
	6		n.w.bn. 1	29 68	0 04
31.	12	Fair	W.n.w. 1	29 65	
	9		W.ſ.w. 0	29 62	
				Total	12 03

JUNE, 1698.

D. b.	*Weather.*	*Winds.*	*Barom.*	*Rain.*	D. b.	*Weather.*	*Winds.*	*Barom.*	*Rain.*
6	Fair	W. 2	29 60		6	Fair			
. 12	and		29 60		17. 12				
9	Hot	S. 0	29 60		9	Cloudy	N. W. 0	30 05	
6	Fair	S.w.bſ. 2	29 57		6		N. W. 0	30 04	
:. 12		W. 3	29 52		18. 12	Fair	N.n.w. 1	30 05	
9	Rain	S. 1	29 50	0 23	9		E. 1	30 08	
6	Cloudy	S. 1	29 51		6		E. 0	30 08	
;. 12	Thund.	N. W. 2	29 55		19. 12	Fair	E b. S. 1	30 0[illegible]	
9		N.byw 0	29 72	0 46	9		E. 0	30 05	
6	Miſling	N.byw. 2	29 81		6	Fair	E.byS. 0	30 03	
{. 12	Fair and	N. 3	29 90		20. 12		E.byS. 0	30 00	
9	Cool	E.S.E. 0	29 99	0 02	9	Hot		29 92	
6	Fair	E.byS. 0	30 01		6	Fair	E.byS. 0	29 8[illegible]	
;. 12	Cloudy	W. 2	30 02		21. 12		S. W. 2	29 86	
9	Fair	S. W. 0	30 04		9	Cloudy	W. 0	29 86	
6	Fair	S. W. 0	30 06		6	Miſling	W.byS. 0	29 86	
5. 12	and	S.S.W. 1	30 07		22. 12		N.byw. 1	29 89	
9	Hotter	0	30 08		9	Cloudy	E. 1	29 90	
6	Fair	W.b.S. 1	30 09		6	Fair	E. 0	29 83	
. 12	and	S.byE. 0	30 09		23. 12	and			
9	Hot		30 10		9	Hot	S.byW. 1	29 73	
6	Fair	E.byN. 0	30 08		6	Rain	S.byW. 2	29 65	
3. 12	Hot	E.byN. 2	30 08		24. 12	and	S. 3	29 61	
9	Cloudy	N.e.bn. 3	30 05 30 08		9	Cooler	S. 2	29 58	0 08
6	Cloudy	N.n.e. 2	30 02		6	Fair	ſ.w.bw. 3	29 62	0 19
). 12	Fair	N.n.e. 3	30 01		25. 12	Rain	S.byW. 3	29 64	
9	Cloudy	N. E. 2	29 95		9	Fairer	S. 0	29 68	0 06
6	Cloudy	N. E. 2	29 86		6	Fair	W.S.w. 1	29 76	
10. 12	Cooler		29 81		26. 12		W.b.S. 1	29 78	
9	Rain	E. 1	29 74	2 25	9	Cloudy	W.b.S. 0	29 80	
6	Cloudy	N.byE. 0	29 68	0 17	6		S. W. 1	29 78	
11. 12	Cloſe	N.byE. 1	29 66		27. 12	Cloudy	W.S.w. 3	29 75	
9	Day		29 62		9		W b.S. 2	29 69	
6	Much	N.n.w. 1	29 57		6			29 69	
12. 12	Rain	N.n.w. 1	29 52		28. 12	Rain			
9		N.n.w. 1	29 47	3 02	9				
6		N. 0	29 42	0 91	6				
13. 12	Miſling				29. 12	Fair			
9		W byS. 1	29 52	0 38	9		W. 1	29 73	
6		W.byS. 2	29 62	0 10	6	Cloudy	W.byS. 2	29 71	
14. 12	Cloudy	S. W. 3	29 67		30. 12	Miſling	W.S.w. 1	29 74	
9		S. W. 2	29 70		9	Cloudy		29 7[illegible]	
6		S. W. 1	29		6			Total	8 77
15. 12					31. 12				
9					9				
6									
6. 12									
9									

JULY, 1698.

D.	h.	Weather.	Winds.	Barom.	Rain.	D.	h.	Weather.	Winds.	Barom.	Rain.
	6		W.n.w.1	29 78			6	Fair, Fair	S. W. 1	29 74	0 06
1.	12	Cloudy	W.b.S.1	29 78		17.	12	Cloudy	S. 3	29 77	
	9		W.S.w.0	29 75			9	Rain	S.b.W. 2	29 73	
	6	Cool	N. 1	29 77			6	Miſling	ſ.w.bw.3	29 51	0 94
2.	12	Rain	N.N.E.2	29 83		18.	12	Rain	S. W. 3	29 56	
	9	Warmer	N. 0	29 88	0 23		9	Fairer		29 75	1 12
	6	Fair	N. 0	29 88			6		W.S.w.1	29 88	
3.	12	and	S. W. 2	29 86		19.	12	Fair	W.b.n. 2	29 87	
	9	Hot		29 82			9			29 87	
	6	Cloudy	S.w.b.ſ.3	29 74			6		W.ſ.w.0	29 84	
4.	12	Miſling	S. W. 3	29 67		20.	12	Hot			
	9	Rain	S. W. 3	29 61			9				
	6		S.b.W. 2	29 52	1 87		6				
5.	12	Fairer	W.S.w.4	29 50		21.	12				
	9	Rain	S. W. 3	29 56	0 05		9				
	6	Cloudy	W.S.w.1	29 66	0 05		6				
6.	12	Hot	ſ.w.bw.3	29 70		22.	12				
	9	Fair	W.b.S. 0	29 75			9				
	6	Fair	S.w.b.ſ.1	29 77			6				
7.	12	Rain		29 76		23.	12				
	9	Fair	S. W. 0	29 73			9				
	6	Miſty	S. W. 0	29 73			6				
8.	12	Very	W.S.w.1	29 75		24.	12				
	9	Hot	S.by E. 0	29 78			9				
	6	Cloudy	E. by S. 1	29 79			6	Thunder & Rain, but fair at *Tunbridge Wells.*			
9.	12	Hot and	E. 1	29 78		25.	12				
	9	Sultry	E. 0	29 76			9				
	6		E. 0	29 73			6				
10.	12	Same	E. b. S.1	29 72		26.	12				
	9		E. 0	29 67			9	Miſling	S. W. 2	29 50	4 10
	6	Thund &	E.S.E. 1	29 59	2 83		6	Fair	W.b.S. 1	29 67	
11.	12	Rain, Rain	S.S.W. 1			27.	12	and	W. 2	29 78	
	9	Fairer	S.by W.0	29 50	0 84		9	Cooler	W.S.w.0	29 83	
	6	Cloudy	N.N.w.1	29 48			6	Fair	S.w.b.ſ.0	29 86	
12.	12		W. 2	29 47		28.	12	Cool and	S.b.w. 3	29 81	
	9	Rain	N. W. 3	29 47	4 49		9	Cloudy	S. 2	29 80	
	6	Cloudy	N.n.w. 1	29 54	0 01		6	Rain	S.by W.3	29 68	0 02
13.	12		n.w.bw.2	29 61		29.	12				
	9	Fair	n.w.bw.0	29 62			9	Fair	W.S.w.0	29 76	
	6	Cloudy	S.w.bw.2	29 63			6	Fair	S. W. 0	29 75	
14.	12	with ſome	S.w.bw.1	29 63		30.	12				
	9	Fair	S.by W 2	29 58			9	Miſling	7	29 41	
	6	Cloudy	S.by W.3	29 48			6	Fair	W.b.S. 5	29 41	0 10
15.	12	Rain	S. 4	29 43		31.	12	Cooler	W. 4	29 52	
	9	Cloudy	S. 2	29 38	0 36		9	Cloudy		29 57	
	6	Fair	N. W. 3	29 43						Total	17 63
16.	12	Cool	W.S.w.4	29 53							
	9	Rain		29 64	0 47						

AUGUST, 1698.

D.	h.	Weather.	Winds.	Barom.	Rain.	D.	h.	Weather.	Winds.	Barom.	Rain.
	6	Fair	S. W. 2	29 51			6	Fair	N. 0	30 10	
1.	12		W.byn. 3	29 49		17.	12		N. E. 1	30 09	
	9	Showers		29 46	0 13		9	Cloudy		30 05	
	6		ſ.w.b.w 1	29 43			6		E. 0	29 95	
2.	12	Showry				18.	12	Cloudy	E. 2	29 94	
	9		N.byE. 1	29 55	0 39		9		S. 1	29 85	
	6		W.b.S. 0	29 60			6	Fairer	S.S.W. 0	29 82	
3.	12	Fair	N. W. 2	29 62		19.	12	Warm	W.ſ.w. 2	29 82	
	9			29 67			9	Cloudy		29 80	
	6	Miſling	ſ.w.b.w 1	29 64			6	Cloudy	S. W. 0	29 76	
4.	12	Fairer	W.n.w. 2	29 65		20.	12		S. W. 3	29 73	
	9	Rain		29 71			9	Fair		29 67	
	6	Fair	W.byn. 0	29 75	0 14		6	Fair	S.w.b.ſ. 1	29 59	
5.	12		W.n.w. 2	29 81		21.	12		S.S.W. 2	29 58	
	9	Showers		29 87	0 40		9	Cloudy		29 55	
	6	Cl. Show.	W.byS. 1	29 88			6	Cloudy	S.S.E. 1	29 44	
6.	12	Fair	W.byS. 3	29 87		22.	12		S. 3		
	9	Cool	N. W. 2	29 87	0 05		9	Rain		29 37	0 10
	6	Fair	n.w.b.w 1	29 84			6	Rain	S. 0	29 48	0 48
7.	12	Fair	N.n.w. 2	29 81		23.	12		S.e.b.e. 2	29 51 29 47	
	9	Fairer	N.n.w. 0	29 80	0 26		9	Thunder		29 48	1 58
	6	Miſty	W.byS. 1	29 72			6	Showers	S.byE. 1	29 42	
8.	12	Cool	N.N.E. 1	29 72		24.	12		S. 3	29 42	
	9	Rain	N.N.E. 0	29 72	1 57		9	Fair		29 42	0 01
	6	Cloudy	ſ.w.b.w 1	29 63	0 01		6	Cloudy	S. W. 1	29 42	
9.	12	Dull	S. W. 2	29 61		25.	12		W.b.n. 1	29 42	
	9	Day		29 58			9	Fair		29 42	
	6		n.w.b.n 1	29 58			6		E.S.E. 0	29 42	
10.	12	Rain	N. 1	29 61		26.	12	Fair	N.W. 2	29 41	
	9		N. E. 0	29 63	1 40		9		N. 1	29 44	
	6	Cloudy	N. 1	29 63			6	Fair and	S. W. 0	29 50	
11.	12	Cool	N.byw. 2	29 65		27.	12	good h.	N. W. 2	29 58	
	9	Day	N. 0	29 67			9	Weather.		29 67	
	6		N.byw. 1	29 69			6		S. W. 1	29 75	
12.	12	Miſling	N. 3	29 70		28.	12	Fair	S. W. 3	29 79	
	9			29 76	0 02		9	Rain		29 76	
	6	Fair and	N.byw. 1	29 79			6		W. 1	29 73	
13.	12	Cool	N. 2	29 84		29.	12	Fair	W.ſ.w. 3	29 76	
	9	Cold	E.byN. 0	29 90			9	Rain		29 73	0 11
	6		N.byE. 0	29 98			6	Some Fair	S. W. 0	29 71	
14.	12	Fair	E. 2	30 01		30.	12	and ſome	S.S.W. 3	29 75	
	9			30 60			9	Rain		29 80	0 35
	6	Fair	S.e.b.e. 0	29 95			6	Cool	N. W. 0	29 83	0 02
15.	12	and	N. E. 2	29 96		31.	12	Fair with	n.w.b.n 2	29 85	
	9	Warm		29 98			9	Rain		29 84	
	6		E. 0	30 00						Total	7 02
16.	12	Same	E.N.E. 2	30 04							
	9			30 09							

SEPTEMBER, 1698.

D.	h.	Weather.	Winds.	Barom.		Rain.	
	6	Cloudy	N.n.w. 0	29	80		
1.	12	Cool	W. 1	29	72		
	9	Day		29	64		
	6		S. W. 1	29	52		
2.	12	Showers	S. W. 3	29	54		
	9			29	56	0	14
	6		S.S.W. 1	29	48		
3.	12	Rain	S. W. 5	29	45		
	9			29	41	2	55
	6	Fair	S. W. 0	29	40		
4.	12		S.by W. 2	29	37		
	9	Rain		29	16	0	20
	6	Fair	W.S.w. 2	29	13	1	10
5.	12	Rain					
	9	Fair	S. W. 3	29	48	0	03
	6	Rain	ſ.w.bw. 2	29	50		
6.	12		S. W. 4	29	46		
	9	Cloudy		29	47	0	09
	6		S.by W. 4	29	41		
7.	12						
	9						
	6	Rain					
8.	12						
	9	Fair		29	76	0	77
	6		S. 0	29	81		
9.	12	Cloudy	S.by W. 2	29	80		
	9		S.by W. 0	29	80		
	6	Fog	S. W. 0	29	86		
10.	12	Fair	S.by W. 1	29	89		
	9	Cloudy	W.by S. 0	29	89		
	6		S. by E. 1	29	81		
11.	12	Rain	S. by E. 2	29 29	70 61		
	9		E. by S. 0	29	31	1	34
	6	Fair	N. 1	29	86	0	01
12.	12	Warm	E. 2	29	92		
	9	Day		29	87		
	6		E. by S. 0	29	70		
13.	12	Cloudy	E. by S. 1	29	61		
	9			29	55		
	6		E. 0	29	57		
14.	12	Fairer	N. E. 2	29	62		
	9			29	63		
	6	Fair	E.N.E. 2	29	60		
15.	12	Warm					
	9	Cloudy		29	51		
	6	Rain	N.e.b.e. 0	29	41		
16.	12	Warm	S.by E. 2	29	44		
	9	Fair		29	46		
	6	Rain	E.by N. 0	29	39		
17.	12		E.by S. 0	29	36		
	9	Fairer		29	34	1	46
	6	Rain	E.by S. 0	29	31		
18.	12		S. E. 1	29	34		
	9	Fairer		29	30	1	43
	6		E.N.E. 1	29	25		
19.	12	Showers	S. W. 3	29	25		
	9			29	31	0	65
	6	Rain	S. W. 1			0	15
20.	12	Cloudy	ſ.w.bw. 2	29	38		
	9	Rain		29	42		
	6	Foggy	S. W. 0	29	46	0	55
21.	12	Showers	W.S.w. 1	29	48		
	9	Fair		29	52	0	01
	6	Hoar-Fr.	ſ.w.bw. 0	29	47		
22.	12	Fair	S. 2	29	41		
	9	Rain		29	37	0	20
	6	Fair	S. W. 1	29	42		
23.	12	Warm	W.S.w. 3	29	42		
	9	Cooler		29	44		
	6	Fair	S.S.W. 0	29	44		
24.	12	Cooler	S.e.b.e. 1	29	43		
	9	Cloudy		29	31		
	6	Rain	S.S.E. 2	29	20	0	42
25.	12						
	9						
	6						
26.	12	Fair					
	9			29	45	0	01
	6	Fair and	S.S.E. 1	29	42		
27.	12	Pleaſant	S. 3	29	42		
	9	Rain		29	41	0	11
	6	Fair	S. 0	29	40	0	03
28.	12	Showers	S. 3	29	36		
	9	Fair		29	26	0	01
	6	Rain	E. by S. 1	29	05	0	04
29.	12	Rain	S. by E. 3	29	06		
	9			29	06	0	76
	6	Rain	S. by E. 2	29	04		
30.	12	Warm	S.S.W. 4	29	07		
	9			29	36	0	40
				Total		12	07

OCTOBER, 1698.

D.	h.	Weather.	Winds.	Barom.	Rain.	D.	h.	Weather.	Winds.	Barom.	Rain.
	7	Miſling	S. 3	29 37			7	Ice and	N.N.w.1	29 62	
1.	12	Warm	S.w.b.ſ 4	29 45		17.	12	Fair			
	9	Fair		29 66			9	Rain		29 57	0 34
	7	Cloudy	S. 2	29 69	0 20		7	Ice	S. 1	29 44	
2.	12	Warm &	S. 3	29 71		18.	12	Cloudy	S. W. 2	29 33	
	9	Fair		29 77			9	Fair		29 15	
	7	Rainy	S. 2	29 83			7	Cold	E S.E. 2	28 98	
3.	12	Warm	S. S. E. 2	29 83		19.	12		S.by E. 2	28 84	
	9	Day	2	29 63	2 87		9	Rain		28 83	1 20
	7	Fair	ſ.w.b.w.1	29 50	1 17		7	Cold	S. W. 2	29 01	0 41
4.	12	Fair		29 5		20.	12	and	W.b S. 2	29 12	
	9	Rain	W.n.w.	29 56	0 36		9	Cloudy		29 24	
	7	Cloudy	W.n.w.2	29 82			7	Froſt and	N. 0	29 23	
5.	12	Fair	N.b.W.3	29 88		21.	12	Fair	N. W. 2	29 24	
	9	Cooler		29 95			9	Cloudy		29 46	
	7		ſ.w.b.w.1	30 00			7	Showers	N.N.E.0	29 50	
6.	12	Cloudy	W.b.N.2	30 03		22.	12	Hail	S. 2	29 51	
	9		W.b.N.0	30 07			9	Showers		29 57	1 41
	7	Cloudy	W. 1	30 07			7	Hard-Fro.	S.e.b.e. 0	29 65	
7.	12	Fair	W.b.N.1	30 07		23.	12	and Fair	E.S.E. 1	29 68	
	9	Cloudy	W. 0	30 07			9	Showers		29 70	
	7	Fair and	N. W. 0	30 10			7	Fair	E. 0	29 62	0 04
8.	12	ſomewhat	N.b.W.1	30 10		24.	12	Warm			
	9	Cooler	N. W. 0	30 11			9	Rain		29 58	0 10
	7	Cloudy	N. W. 0	30 07			7	Rain	S. 3	29 40	0 11
9.	12	and	W.ſ.w. 1	30 03		25.	12	Mild	S. by E. 3	29 24	
	9	Cooler	S. W. 3	29 88			9	Weather		29 42	
	7	Rain	W.b.N.3	29 62	1 55		7	Cloudy	S.S.E. 2	29 48	
10.	12	Fair	W.n.w.3	29 76		26.	12	F.&Warm	S.E.b.S.3	29 47	
	9	Rain	S. W. 3	29 61			9	Rain		29 43	
	7	Cloudy	W.b.N.3	29 35	0 63		7	Fair	S.by W.0	29 52	
11.	12	Fair	W.b.N.3	29 36		27.	12	Cloudy		29 52	
	9	Cloudy	W.b.N.3	29 37			9	Rain		29 42	0 80
	7	Cloudy	W. 2	29 30			7	Miſt	W. 0	29 41	
12.	12	and ſome	W. 3	29 30		28.	12	Fairer	N.N.E.2	29 24	
	9	Rain		29 27	0 23		9	Rain		29 46	0 05
	7	Fair	W.byS.0	29 14	0 02		7	Cloudy	N.byE. 2	29 41	
13.	12	Warm	N. 2	29 09		29.	12	Colder	N.byE. 1	29 41	
	9	Cold		29 08			9	Rain		29 41	
	7	Fair	W.byN.	29 20			7	Snow	N.byE. 4	29 62	1 23
14.	12	Rain	N.byE.2	29 30		30.	12	Sleet	N. 3	29 23	
	9	Cloudy		29 42	0 07		9	Fairer		29 42	0 29
	7	Hoar-Fr.	n.w.b.n0	29 47			7	Hard-Fro.		29 62	
15.	12	Fair and	n.w.b.n1	29 47		31.	12	Cloudy			
	9	Cold		29 47			9			29 76	
	7	Icy Froſt	N.n.w. 1	29 50						Total	13 08
16.	12	Fair and	N.b.W.1	29 53							
	9	Cold		29 61							

NOVEMBER, 1698.

D.	h.	Weather.	Winds.	Barom.	Rain.	D.	h.	Weather.	Winds.	Barom.	Rain.
	8	Froſt	S.w.b.ſ.2	29 68			8	Froſt	S. 0	29 67	0 18
1.	12	Sleet	S. W. 2	29 62		17.	12	and			
	9	Cloudy		29 63	0 12		9	Fair		29 37	
	8	Fair	S.S.W.0	29 67	0 06		8	Rain	S.e.byſ.2	29 07	
2.	12	Warmer	S.S.W.1	29 68		18.	12	Fair and	ſ.w.b.w2	29 16	
	9	Showers		29 64	0 03		9	Cold		29 31	0 04
	8	Fair	S. 1	29 55			8	Rain and	S.byE. 2	29 28	
3.	12					19.	12	Co. Thaw	S.w.b.ſ.3	29 14	
	9	Cloudy	S byW.3	29 49			9	Fair		29 20	0 10
	8	Showers	S. 3	29 40			8	Rain	S. W. 2	29 20	0 44
4.	12	Warm &	S. 3	29 30		20.	12	Fair and	S. W. 4	29 27	
	9	Cloudy	S. 4	29 15	0 11		9	Warm		29 31	
	8	Rain	W.S.w.5	29 98	0 19		8	Rain	S. W. 4	29 14	2 81
5.	12	Fair and	ſ.w.b.w6	29 14		21.	12	Fair and	S. W. 3	29 20	
	9	Pleaſant	ſ.w.b.w0	29 37			9	Warm		29 48	
	8	Froſt	ſ.w.b.w0	29 45			8	Froſt and	W.byS.1	29 77	
6.	12	Fair and	S.byW.0	29 45		22.	12	Fair		29 83	
	9	Cold	S byW.0	29 43			9	Cloudy		29 75	
	8	Rain	ſ.w.b.w3	29 22	0 26		8	Rain and			
7.	12	Fair and	W.byS.4	29 28		23.	12	Warm			
	9	Warmer	ſ.w.byſ.1	29 42			9				
	8	Rain	S. 1	29 24			8				
8.	12		W.byS.2	29 12		24.	12	Rain			
	9	Fairer	W.S.w.2	29 27	2 30		9	Stormy		29 75	1 15
	8	Fair	S. W. 3	29 33	0 23		8	Some	S.w.b.ſ.8	29 15	0 61
9.	12	Cloudy	W.S.w.2	29 22		25.	12	Fair	S.w.b.ſ.8	29 30	
	9	Snow	S.S.E. 1	29 27			9	Some Rain	3	29 52	0 15
	8	Cloudy	W.S.w.0	29 42	0 36		8		S. W. 4	29 41	
10.	12	Miſty	ſ.w.byſ.1	29 48		26.	12	Rain	ſ.w.b.w5	29 33	
	9	Day		29 47			9			29 30	0 07
	8	Sn. & Sleet	N.byE.1	29 48			8	Small Fr.	W.S.w.3	29 25	
11.	12	all Day.	N.byE.1	29 47		27.	12	and	W.S.w.3	29 27	
	9	Snow		29 43	2 66		9	Fair		29 53	
	8	Snow 3	N.byw.2	29 46	2 56		8		W.byS.1	29 41	
12.	12	Inches,	N.byw.1	29 54		28.	12	Same	W.byn.1	29 44	
	9	Cloudy		29 65	0 65		9			29 37	
	8	Hard-Fr.	W.byS.0	29 60			8	Snow	E.byN.1	29 13	
13.	12	and	W.S.w.1	29 58		29.	12		E.byN.2	29 09	
	9	Fair		29 62			9	Sleet		29 17	0 74
	8	Fair, Snow	W.S.w.1	29 63			8	Froſt and	N.byw.4	29 55	
14.	12	and Hard.	W.byS.2	29 61		30.	12	Fair	N.N.w.2	29 66	
	9			29 70			9	Rain		29 86	0 01
	8	Froſt	N.n.w. 1	29 90						Total	16 8
15.	12	Miſty and	W.b.N0	29 98							
	9	leſs Cold		30 01							
	8	Cloudy	S. 1	29 92							
16.	12	Fair	S. S. E. 2	29 92							
	9	Thaw		29 81							

DECEMBER, 1698.

D.	h.	Weather.	Winds.	Barom.	Rain.
	8	Hard-Fr.	N.byw.o	29 85	
1.	12	Fair	E. by S.c	29 8c	
	9	Sn. 3 Inc.		29 78	
	8		W.n.w.o	29 93	
2.	12	Foggy	W.byN.	30 01	
	9			30 11	
	8	Cloudy	W.b.S. o		
3.	12	with gen-	W.b.S. o	30 15	
	9	tle Thaw	W.b.S. o	30 16	1 32
	8		W.b.S. o	30 09	
4.	12	Foggy	S. W. c	30 08	
	9		S.w.b.ſ.o	30 06	
	8	Fog and	S.w.b ſ.o	30 02	
5.	12	Miſling	S.byW.c	30 03	
	9		S.byE. c	30 00	0 41
	8	Fog	E. S. E. 1	29 97	
6.	12	Warm	E. 2	29 94	
	9	Clearer	S.e.b.e. 1	29 92	
	8	Miſty	S. E. c	29 92	
7.	12	Clearer	S. E. c	29 91	
	9	Miſty	E. byS. c	29 88	
	8	Miſt	E.byS. c	29 83	0 04
8.	12	Fair	E.byS. 1	29 86	
	9	Fog	S.w.b.ſ.c	29 94	0 12
	8	Rain	S.byW.2	29 99	0 03
9.	12	Cloudy	S.byW.3	29 98	
	9	& warm	S.S.W. 4	29 91	
	8	Cloudy	S. 6	29 66	
10.	12	Rain	W.byS.6	29 64	
	9	Fair	W.byS.2	29 96	0 49
	8	Fair and	W.S.w.4	30 1c	
11.	12	Cooler	S. W. 3	30 14	
	9	Cloudy		30 00	
	8	Rain	W.n.w.3	29 79	0 72
12.	12	Fair			
	9			30 11	
	8	Froſt	S.e.b.ſ. c	30 1c	
13.	12	Fair	S. S.E. 1	30 06	
	9	Cloudy		29 96	
	8				
14.	12				
	9	Rain			
	8				
15.	12				
	9				
	8	Cloudy	S.byW.2	29 6c	0 01
16.	12	Rain	S. 3	29 5c	
	9	Warm	7	29 44	
	8	Rain	S.b. W.6	29 09	
17.	12	Warm	S.byW.6	29 1c	
	9	Clou. Rain		29 22	0 42
	8	Cloudy	S.w.b.ſ.3	29 32	0 40
18.	12	and	S.w.b.ſ.2	29 30	
	9	Warm		29 34	
	8	Fair	S byW.o	29 72	
19.	12	Cooler	S.byE. 1	29 67	
	9	Rain		29 35	
	8		S. 3	29 23	0 56
20.	12	Rain	S.byE. 5	28 98	
	9			28 68	0 24
	8	Fair and	W. 4	29 36	
21.	12	Colder	W. 3	29 52	
	9	Rain		29 52	
	8		W.byS.4	29 49	0 17
22.	12	Fair	W.S.w.3	29 55	
	9			29 66	
	8			29 81	
23.	12	Cloudy			
	9		6	29 65	
	8	Cloudy	S. W. 7	29 34	
24.	12	Warm	W.b.n. 8	29 56	
	9	Fair	2	29 82	
	8		W.byS.2	29 94	
25.	12	Fair	W.S.w.2	29 95	
	9			30 00	
	8	Cloudy	W.byS.3	29 93	
26.	12	and	W.byS.4	29 90	
	9	Warm		29 77	
	8	Rain	W.byS.4	29 50	
27.	12	Colder	ſ.w.b.w4	29 43	
	9	Fairer			0 21
	8	Froſt and	S. W. 3	29 49	
28.	12	Fair			
	9	Froſt		29 40	
	8	Warmer	S. W. 7	28 88	
29.	12	Rain	S. W. 8	28 79	
	9	Colder		28 69	
	8	Snow	W.byS.3	28 79	0 69
30.	12	Froſt and	W.byS.3	28 89	
	9	Fair			
	8	Froſt	W. o	29 23	
31.	12	and	W.n.w.2	29 36	
	9	Fair		29 67	
				Total	5 83

XXV. *The Rain, 1697 and 1698, at* Townley; *by Mr.* Townley, n. 249. p. 47.

	1697		1698			1697		1698	
Jan.	10	26	12	94	*July*	27	00	20	74
Feb.	14	34	11	76	*Auguſt*	80	50	43	00
March	9	86	40	32	*Septemb.*	63	80	43	58
April	8	24	41	90	*October*	55	20	44	52
May	23	76	17	90	*Novemb.*	21	44	49	44
June	17	84	12	90	*Decemb.*	49	00	40	84
					Sum	411	24	379	84

As far as I have learned, the Mercury riſes and falls much after the ſame Meaſure in moſt Parts of our Iſland; and of this you may better judge by ſome Obſervations I have here tranſcribed and ſent you, of the very low Stations: *December* 28, about three of the Clock, Mercury 28, 17; on the twenty ninth about two Hours and an half 28, 18; and *Jan.* 2, about the ſame Hour, 28, 05; and this time it hardly roſe before I went to Bed; and on the ſixth ſtill about three Hours 28, 19; but this time before nine at night it was got to 29, 28. What I note is, that though once I ſaw it lower many Years ago, yet never ſince I kept my Obſervations, did the Quick-ſilver deſcend ſo often to thoſe Pitches; or when it was found very low, did it ever continue ſo for any conſiderable Time, as it hath done this Year; during which it hath never been very high, and, as I remember, generally much lower than other Years. This hath proved very unſeaſonable here, and ſo backward, that I thought I had never known the like; but examining my Obſervations, I find that of 1673 much what as late, tho' the Conſequence proved not ſo fatal to theſe Parts of *Europe*, as this.

The Weather 1698 *and* 1699, *at* Emuy *in* China; *by Mr.* James Cunningham, n. 256. p. 323.

XXVI. At *Emuy* in *China* in the Latitude of 24°. 20'. N. *An.* 1698, *Octob.* From 1 to 8, the Weather was fair and clear, the Mercury's Alt. $29\frac{14}{20}$ Digit. From the eighth to the eleventh, cloſe and cloudy Weather, the Mercury falling to $29\frac{12}{20}$ Dig.

11. Cloſe Weather, ſomewhat cloudy. 12. Cloſe Weather, blowing freſh at *N. E.* 13. and 14. Cloſe and cloudy Weather, with much Rain, and freſh Winds from *N. E.* to *N. W.*

The *Tides*, (which commonly flow three Fathoms) did flow above half a Foot higher three Days after the Full-Moon, than it did on the Full-Moon at the Æquinox.

15. Fair and clear Weather, with ſmall Gales at *N. E.* From the fifteenth to the twenty-fourth, fine, moderate, fair Weather, with ſmall Gales at *N. E.* From thence to the thirty-firſt, Winds and Weather variable.

Nov. 1 to 15. Variable, cloſe and cloudy Weather, with ſome Rain, and variable Gales round the Compaſs.

15. Fair and clear Weather, with ſmall Gales at *N. E.* in the Morning the Mercury's Alt. $29\frac{15}{20}$, at Noon $29\frac{14}{20}$, and at ten of the Night, being cold, riſing

ſing to 29$\frac{16}{20}$, 16. At Sun-riſing very cold, the Mercury's Alt. 29$\frac{16}{20}$; at Noon fair and pleaſant Weather, the Mercury falling to 29$\frac{17}{20}$; at Night cold, riſing to 29$\frac{18}{20}$; the Wind at *N. E.* 17. This Morning cold, the Mercury at 29$\frac{18}{20}$, fair and clear Weather all Day, and at Night blowing ſomewhat freſh at *N. E.* the Mercury at 29$\frac{17}{20}$. 18. This Morning cold, the Mercury at 29$\frac{17}{20}$; all Day fair and pleaſant Weather, the Mercury falling to 29$\frac{14}{20}$, and by Noon to 29$\frac{12}{20}$; the Weather fair, ſomewhat cloſe and cloudy, the Afternoon Sun-ſhining and warm, and at Night temperate, the Mercury continuing at 29$\frac{12}{20}$; ſmall Winds at *N. E.* and almoſt calm.

20. A pleaſant Sun-ſhining Morning, the Mercury at 29$\frac{11}{20}$; at Noon overcaſt and cloudy, with little Wind at *N. E.* the Mercury falling to 29$\frac{10}{20}$; in the Afternoon ſome Drops of Rain, with cloſe Weather, and at Night the Mercury continuing at 29$\frac{10}{20}$, with ſmall Weſterly Winds; ſome Rain in the Night. 21. Cloſe and cloudy Weather, with ſmall Gales at *N. E.* the Mercury at 29$\frac{10}{20}$ in the Morning, and continuing ſo all Day, with ſome Drops of Rain in the Afternoon, the Gale freſhning, and a Shower of Rain at eight of the Night, the Mercury riſing to 29$\frac{13}{20}$. 22. Gray and cloudy Weather all Day, with freſh Gales between *E.* and *N. E.* the Mercury at 29$\frac{10}{20}$, and at Night riſing to 29$\frac{13}{20}$; fair Weather, ſomewhat cloudy. 23. A very cold Morning, fair and clear, with freſh Gales from *N. E.* to *N.* the Mercury at 30 Dig. fair and clear all Day, with a moderate Gale about *N. E.* clear and very cold all Night, the Mercury continuing at 30 Dig. 24. A fair, clear and cold Morning, the Wind at *N. E.* a moderate Gale, the Mercury continuing at 30 Dig. a clear Sun-ſhining Day, cold and clear all Night, the Mercury as before. 25. A ſharp, cold Morning, fair and clear, with a moderate Gale at *N. W.* the Mercury falling to 29; all Day fair and pleaſant, very warm, and no Wind, the Mercury falling at Noon to 29$\frac{12}{20}$, and at Night being ſomewhat hazy and calm withal, to 29$\frac{14}{20}$. 26. Temperate Weather all Night, and this Morning ſomewhat cloſe and hazy, and no Wind, the Mercury at 29$\frac{14}{20}$, and towards Noon growing clearer and warmer, riſing to 29$\frac{16}{20}$; ſmall Breezes at *N. E.* at Night falling to 29$\frac{14}{20}$, temperate Weather. 27. Fine, pleaſant Weather all Day, with ſmall, variable Breezes from the *N.* to *W.* and about to *S.* the Mercury in the Morning at 29$\frac{14}{20}$, and at Noon falling to 29$\frac{12}{20}$, and at Night riſing to 29$\frac{14}{20}$, fair Weather and calm. 28. Fine, moderate Weather, with a Gale at *N. E.* the Mercury at 29$\frac{14}{20}$; in the Afternoon the Gale freſhned, the Weather ſomewhat cloudy, and at Night the Mercury was at 29$\frac{13}{20}$; blowing freſh. 29. Fair and clear Weather, ſomewhat cold this Morning, with a freſh Gale at *N. E.* the Mercury at 29$\frac{18}{20}$, fine, pleaſant Weather all Day, with ſmall Gales at *N. E.* at Noon the Mercury falling to 29$\frac{15}{20}$, and at Night being clear and ſomewhat cold, riſing to 29$\frac{17}{20}$. 30. Fair and pleaſant Weather, with ſmall Gales at *N. E.* the Mercury at 29$\frac{17}{20}$; at Noon a freſh Gale, the Mercury falling to 29$\frac{14}{20}$; at Night temperate Weather, and little Wind, the Mercury riſing to 29$\frac{16}{20}$.

Dec. 1. Fine, temperate Weather, with ſmall Gales at *N. E.* the Mercury at 29$\frac{16}{20}$ in the Morning; fair Weather all Day, and ſmall Breezes at *N. E.* the Mercury at Noon falling to 29$\frac{14}{20}$, and in the Evening to 29$\frac{12}{20}$, and at Night riſing to 29$\frac{13}{20}$, being fine, clear Weather. 2. Fair and temperate

Weather, ſomewhat cloudy, and overcaſt, with ſmall Gales at *N. E.* the Mercury at $29\frac{14}{20}$, and at Night riſing to $29\frac{15}{20}$. 3. A clear and cold Morning, with a fine ſharp Gale at *N. b. E.* the Mercury at $29\frac{17}{20}$; a cold Air all Day, the Mercury at Noon falling to $29\frac{15}{20}$, and at Night the Gale freſhning made it colder, the Mercury riſing to $29\frac{18}{20}$. 4. A ſharp Morning, with a freſh Gale at *N. b. E.* the Mercury at $29\frac{19}{20}$; fair and clear all Day, with a ſmall Northerly Gale, the Mercury by Noon falling to $29\frac{15}{20}$; a ſerene, temperate Night, and almoſt calm, the Mercury as before. 5. A fine, clear Morning, with a moderate Gale at *S. W.* ſomewhat cold, the Mercury at $29\frac{15}{20}$; at Noon a ſmall Breeze at *E. b. S.* pleaſant Weather, the Mercury at $29\frac{18}{20}$; at Night a ſmall Gale at *S. b. E.* fair and temperate Weather, ſomewhat hazy, the Mercury at $29\frac{13}{20}$.

6. This Morning ſomewhat cloſe and cloudy, with a few Drops of Rain, the Weather temperate, with ſmall Southerly Breezes, the Mercury at $29\frac{15}{20}$, the Afternoon calm, and ſomewhat hazy, the Mercury falling to $29\frac{10}{20}$; at Night overcaſt and cloudy, with ſome Rain, blowing freſh at *N.* the Mercury riſing to $29\frac{14}{20}$. 7. A gray Morning, clearing up with a freſh Gale at *N. E.* the Mercury at $29\frac{17}{20}$; in the Afternoon the Horizon a little hazy, the Mercury falling to $29\frac{15}{20}$; at Night clearer, with a freſher Gale, the Mercury riſing to $29\frac{18}{20}$; a very cold Night. 8. A ſharp, clear Morning, with a fine Gale at *N. E.* the Mercury at 30; at Noon falling to $29\frac{18}{20}$, a fine Sunſhining Day; at Night cold and clear, a ſmall Gale at *N. E.* the Mercury riſing to 30. 9. This Morning as the laſt, all Day and Night the ſame, and the Mercury alſo.

10. A cold Morning, ſomewhat foggy, with a fine Gale at *N. E.* the Mercury at 30; all Day fair, clear, and ſun-ſhining; at Night cold, the Mercury at $29\frac{19}{20}$. 11. A cold Morning, with a moderate Gale at *N. W.* the Mercury at $29\frac{18}{20}$; all Day fair and clear, the Mercury falling to $29\frac{16}{20}$; at Night a freſh Gale at *N. E.* the Mercury at $29\frac{19}{20}$. 12. A gray, cold Morning, ſomewhat cloudy, with a hazy Horizon, a freſh Gale at *N. E.* the Mercury at $29\frac{19}{20}$; towards Noon falling to $29\frac{17}{20}$, with little Wind and fair Weather; at Night calm, and ſomewhat cold, the Mercury riſing to $29\frac{18}{20}$. 13. A fine pleaſant Morning, with a ſmall Breeze at *N. W.* the Mercury at $29\frac{18}{20}$; at Noon a ſmall Gale at *N. E.* and in the Afternoon calm, the Mercury falling to $29\frac{14}{20}$; all Day ſerene, at Night calm, with a clear Sky, ſomewhat cold, the Mercury riſing to $29\frac{15}{20}$. 14. A fine temperate Morning, with ſome ſmall Rain like Dew, and a moderate Gale at *S. W.* the Mercury $29\frac{15}{20}$; the Afternoon a little overcaſt, and the Horizon ſomewhat hazy, a ſmall Gale at *S. E.* the Mercury falling to $29\frac{12}{20}$; at Night temperate and calm, the Mercury riſing to $29\frac{14}{20}$. 15. A fine, temperate, calm Morning, the Mercury at $29\frac{15}{20}$; at Noon fair, pleaſant, calm Weather, the Mercury fallen to $29\frac{12}{20}$; all the Afternoon, and at Night, a freſh Gale at *N. E.* fair Weather, the Mercury riſing to $29\frac{15}{20}$. 16. A gray, cloudy Morning, ſomewhat hazy, with a freſh Gale at *N. E.* the Mercury at $29\frac{17}{20}$; at Noon fair and clear, the Gale moderate, and the Mercury falling almoſt to $29\frac{14}{20}$; the Afternoon ſomewhat cloudy, with a fine Gale at *N. E.* at Night a little Wind, ſerene and ſharp, the Mercury riſing to $29\frac{18}{20}$. 17. A gray Morning,

Morning ſomewhat cold, with a fine Gale at *N. E.* the Mercury at $29\frac{17}{20}$ and at Noon falling to $29\frac{15}{20}$; at Night little Wind, the Mercury riſing to $29\frac{16}{20}$. 18. A fair temperate, calm Morning, ſomewhat foggy, the Mercury at $29\frac{17}{20}$; all Day fair Weather, ſomewhat cloudy, with ſmall Winds at *N. E.* the Mercury falling to $29\frac{15}{20}$; at Night blowing freſh, the Mercury riſing to $29\frac{18}{20}$. 19. A grey, cloudy Morning, with a freſh Gale at *N. E.* the Mercury at $29\frac{18}{20}$; cloſe, thick Weather, with continual Rain all Day and Night, and a moderate Gale at *N. E.* at Night the Mercury riſing to $29\frac{12}{20}$. 20. Cloſe, thick, rainy Weather, in the Morning, with a moderate Gale at *N. E.* the Mercury falling below $29\frac{18}{20}$; and by Noon to $29\frac{16}{20}$; continual thick, rainy Weather all Day and Night, the Mercury at $29\frac{16}{20}$, and the Gale as before.

21. A grey, cloudy Morning, but fair, and beginning to clear up, and calm withal, the Mercury at $29\frac{14}{20}$; at Noon fair Weather, and ſomewhat clear, with a ſmall Gale at *S. W.* the Mercury falling to $29\frac{13}{20}$; at Night calm and ſomewhat cloudy, the Mercury at $29\frac{14}{20}$. 22. A grey, cloudy Morning, continuing ſo all Day, with a ſmall Gale at *N. E.* the Mercury at $29\frac{14}{20}$, at Night riſing to $29\frac{15}{20}$. 23. A grey, cloudy Morning, continuing ſo all Day, with ſmall Gales at *N. E.* the Mercury at $29\frac{14}{20}$; at Night more ſerene, the Mercury riſing to $29\frac{15}{20}$. 24. A grey Morning, and calm Weather, the Mercury at $29\frac{15}{20}$; cloſe and cloudy Weather all Day, and no Wind, the Mercury falling to $29\frac{14}{20}$; at Night riſing almoſt to $29\frac{15}{20}$. 25. A grey, cloudy Morning (ſome Rain before Day-light) with ſmall *Southerly* Breezes, the Mercury at $29\frac{14}{20}$. Towards Noon Sun-ſhining and pleaſant, little Wind variable, the Mercury falling to $29\frac{13}{20}$; the Afternoon, and at Night, overcaſt and cloudy, the Wind at *S. b. E.* and the Mercury riſing to $29\frac{14}{20}$. 27. A fine pleaſant Morning, with a hazy Horizon, and altogether calm, the Mercury at $29\frac{13}{20}$, and by Noon at $29\frac{13}{20}$; all Day pleaſant Weather, and at Night ſmall Gales at *North Eaſt*, the Mercury riſing to $29\frac{14}{20}$. 28. A fine, pleaſant Morning, with a ſmall Breeze at *E. N. E.* the Horizon ſomewhat hazy, and the Mercury at $29\frac{13}{20}$, at Noon falling to $29\frac{12}{20}$; all Day fair and pleaſant Weather, with the aforeſaid Breeze; at Night calm, the Mercury falling almoſt to $29\frac{2}{20}$. 29. A grey Morning, with a cloſe Horizon, and a ſmall Breeze about *E. N. E.* the Mercury at $29\frac{2}{20}$; calm all the Forenoon, in the Afternoon pleaſant Weather, with a ſmall Gale at *S. E.* the Mercury at $29\frac{3}{20}$; at Night calm, the Mercury at $29\frac{2}{20}$. 30. A grey, cloudy Morning, and cloſe Weather, with a freſh Gale at *S. E.* the Mercury at $29\frac{12}{20}$; all Day cloudy and dark, the Gale freſhening and veering to *E. N. E.* the Mercury riſing to $29\frac{13}{20}$. 31. Grey, cloudy Weather all Day, with a freſh Gale at *N. E.* in the Evening ſome Rain, blowing freſh all Night.

Jan. 1, 1699. Variable Weather, with ſmall Gales at *N. E.* 2. Rainy, thick Weather all Day and Night, with little Wind at *N. E.* 3. Continual thick, rainy Weather all Day and Night, the Wind at *N. E.* 4. Fair Weather, ſomewhat cloſe, and calm all Day and Night. 5. Cloſe Weather, with ſome Rain, and calm this Forenoon; and in the Afternoon a ſmall Breeze at *W. N. W.*

XXVII. *The Weather* 1699 *at* Upminſter; *by Mr.* Will. Derham, n. 262. p. 527.

JANUARY, 1699.

D.	h.	Weather.	Winds.	Clouds.	Barom.	Ther.	Rain.
	8	Froſt	S. e. b. ſ. 0		29 77		
1.	12	Fair	S. S. E. 1		29 73		
	9	Snow			29 43		
	8	Rain	S. 3		29 20		0 63
2.	12	Warmer					
	9	and Rain	S by E. 3		28 76		0 29
	8		S. 3	S. by W.	28 57		0 37
3.	12	Same					
	9		S. by W. 3		28 47		
	8	Cloudy	S. S. W. 3	S. w. b. w.	28 44	110	
4.	12	Fairer	S. W. 4		28 56	109	
	9		S. W. 4		28 72	108	
	8	Froſt	S. W. 3		29 22	85	
5.	12	and Fair	S. 1		29 29	94	
	9	Rain					
	8	Rain	S. 0		28 67	104	0 75
6.	12	Warm			25 61	105	
	9	Snow	S. 8				3 48
	8	Small Fr.	S. W. 2		29 00	85	
7.	12	Fair	S. w. b. w. 3	S. by W.	29 08	86	
	9	Rain	S. by W. 0	S. W.	29 19	85	0 03
	8	Froſt	S. W. 0	W. S. W.	29 34	85	
8.	12	and	W. by S. 1	S. W.	29 44	88	
	9	Fair			29 70	88	
	8	Hard Fr.			29 72		
9.	12	and					
	9	Fair			29 73		
	8		E. by S. 1	E. S. E.	29 82	85	
10.	12	Same	S. e. b. e. 2		29 82	89	
	9				29 60		
	8	Rain	S. W. 2	W. S. W.	29 59	101	0 40
11.	12	Cloudy	S. w. b. w. 2	W.	29 59	99	
	9				29 71	102	
	8	Cloudy	S. w. b. ſ. 0		29 69	103	
12.	12	Miſling	S. W. 2		29 66	109	
	9	Rain		W. by S.	29 59	101	
	8	Fair	S. w. b. w. 3	W.	29 48	93	0 16
13.	12	Cloudy	W. by S. 3	W. by N.	29 42	107	
	9	Rain			29 48	93	
	8	Fairer	N. w. b. w. 4	N. W	29 53	94	0 14
14.	12		N. by W. 4	N. by W.	29 69		
	9	Cloudy			29 97	96	
	8	Rain	N. 1		30 12	90	0 16
15.	12	Cloudy	N. by W. 1		30 14	94	
	9	Day			30 17	82	
	8	Froſt	W. by S. 0	N. by W.	30 10	81	
16.	12						
	9	Cloudy			30 15	90	
	8		n. w. b. w. 0		30 22	94	
17.	12	Foggy	N. W. 0		30 24	100	
	9				30 27	94	
	8	Fog	W. 0		30 26		
18.	12						
	9						
	8	Fog					
19.	12						
	9				30 34	77	
	8	Hard Fr.	S. 0		30 27	70	
20.	12	Fair	S. by E. 1		30 24		
	9	Foggy			30 21	76	
	8	Hard Fr.	S. by E. 0		30 18	62	
21.	12	Fog	E. N. by 1	E. N. E.	30 18	82	
	9	Fair			30 18	81	
	8	Froſt	E. by N. 1		30 16	77	
22.	12	and	E. by N. 2	E. by N.	30 18	86	
	9	Fair			33 19	84	
	8	Cloudy	N. E. 2		30 15	87	
23.	12	Fair					
	9	Small Fr.			30 13	81	
	8	Froſt	E. by N. 0		30 13	73	
24.	12	and	E. 2		30 14	88	
	9	Fair			30 12	88	
	8	Froſt	E. 0		30 11	73	
25.	12	Fair and	E. 1		30 12	86	
	9	Pleaſ. D.			30 09	79	
	8		E. 0		30 05	70	
26.	12	Same	E. 1			88	
	9				29 96		
	8	Froſt and	E. N. E. 0	E.	29 76	76	
27.	12	Cloudy	E. by N. 1		29 72	85	
	9	Fair			29 59	76	
	8	Rain	S. E. 2	S. E. by S.	29 48	89	
28.	12	and	E. by S. 2	S.	29 47	92	
	9	Thaw			29 66	93	1
	8	Froſt	S. w. b. ſ. 0	W. by N.	29 86	85	
29.	12	Fair	S. 1		29 87	92	
	9	Rain			29 72	98	
	8	Cloudy	S. 2	S.	29 56	107	0
30.	12	Warm	S. 3	S. by W.	29 49	115	
	9	Day	S. S. W. 3	S. W. b. S.	29 42	109	
	8	Cloudy	S. by W. 2	W. S. W.	29 49	108	0
31.	12		S. 3		29 37	113	
	9	Rain	S. S. E. 2	S. S. E.	29 47	109	
					Total		8

FEBRUARY, 1699.

D.	h.	Weather.	Winds.	Clouds.	Barom.	Ther.	Rain.
	7	Fair	S. W. 1		29 43	98	
1.	12	Pleaſant	W by S. 2	S. W.	29 53	108	
	9	Day	W. by S. 0		29 77	83	
	7	Small Fr.	W. S. W. 0	W. n. w	29 88	79	
2.	12	Hazy	S. by W. 0		29 91	95	
	9	Rain	S. 1		29 85	100	0 05
	7	Rain	S. S. E. 3	S by E.	29 59	100	
3.	12		S. by W. 3	S. W.	29 51	105	
	9	Fair	S. w. b. w. 1		29 64	92	1 05
	7	Small Fr.	W. S. W. 1	W. n. w	29 74	82	
4.	12	FairCloud.	W. 2	N. by W.	29 80	101	
	9	Rain	S. 1	S. W.	29 73	89	
	7	Cloudy	S. w. b. w. 3	W. S. W.	29 48	104	0 37
5.	12	Fair	W. S. W. 3	W.	29 51	113	
	9	Rain	W. by S. 3	W.	29 48	91	
	7	Small Fr.	W. by N. 1		29 70	85	
6.	12	Fair					
	9	Rain			29 52	93	
	7	Violent	W. 8	W. by N.	28 99	103	1 52
7.	12	Storms	W. n. w. 10	N. W.	29 22	101	
	9				29 78	92	
	7	Cloudy	N. W. 0	N. w. b. n.	29 98	88	
8.	12	Fair	S. b. W. 1	N. W.	30 00	101	
	9	Cloudy			29 88	99	
	7	Miſling	W. S. W. 3	W. by N.	29 79	100	
9.	12						
	9	Fair			30 07	87	0 20
	7	Hoar Fr.	S. W. 2	N. N. W.	30 02	88	
10.	12	Some-	W. 3	N.	30 03	109	
	9	whatFair			30 01	95	
	7	Cloudy	W. by S. 1	N. W.	29 98	87	
11.	12		S. W. 2	W. by N.	29 99	107	
	9	Fairer			29 98	96	
	7	Fair	S. W. 2	N. by W.	29 94	84	
12.	12	Hazy	S. W. 3	N. W.	29 84	102	
	9	Cloudy Ra.	W. 5		29 46	101	
	7		W. 4	W.	29 34	107	0 02
13.	12						
	9						
	7						
14.	12						
	9						
	7						
15.	12						
	9						
	7	Rain					1 50
16.	12	Cloudy	E. by N. 2	N. E.	29 37	102	
	9				29 52	97	
	7		E. by N. 0		29 76	93	
17.	12	Cloudy	E. by N. 1	W. b. S.	29 82	109	
	9	Rain			29 83	94	
	7	Fair and	N. N. W. 1		29 84	91	0 09
18.	12	Pleaſant	N. W. 1		29 93	110	
	9	Rain			29 80	99	
	7		W. by S. 3		29 71	87	0 13
19.	12	Fair	W. by N. 4		29 77	104	
	9				29 94	90	
	7	Froſt	W. S. W. 1		30 00	82	
20.	12	and					
	9	Fair			29 98	97	
	7	Cloudy	W. S. W. 1	W. n. w.	29 94	92	
21.	12		W. by N. 2		29 92	110	
	9	Fairer			29 91	90	
	7	Cloudy	W. b. S. 2	W. n. w.	29 81	84	
22.	12	Sleet	N. W. 3		29 72	100	
	9	Cold			29 75	79	0 09
	7	Hoar Fr.	N. W. 2		29 83	75	
23.	12	Fair					
	9	Sleet			29 59	86	
	7	Cloudy	N. N. W. 0		29 60	92	0 40
24.	12	Bluſter.					
	9	Fairer			29 91	85	
	7	Fair	N. w. b. w. 1		29 90	83	
25.	12	Cloudy	S. w. b. w. 1	N. W.	29 82	102	
	9	Rain			29 75	96	
	7	Fair	W. 1	W. n. w	29 77	86	0 08
26.	12	and	W. by N. 1		29 83	105	
	9	Pleaſant			29 77	95	
	7	Rain	W. b. S. 2	W. b. N.	29 64	99	
27.	12		n. w. b. w. 3		29 67	103	
	9	Fair			29 71	92	0 45
	7	Cloudy	S. W. 3	W.	29 58	93	
28.	12						
	9						0 10
					Total		6 05

MARCH, 1699.

D. b.	Weather.	Winds.	Clouds.	Barom.	Ther.	Rain.	D. b.	Weather.	Winds.	Clouds.	Barom.	Ther.	Rain.
6	Fair						6	Fair	S. 2	S. b. W.	29 84	108	
1. 12							17. 12	Hail					
9	Sleet	N.byE.2		29 26	86	0 12	9				30 12	97	0 0
6	Snow	N.b.w. 3		29 40	82		6	Small Fro.	S. W. 0		30 19	78	
2. 12	Fair						18. 12	Fair and	W. 2		30 22	112	
9				29 64	80	0 04	9	Pleaſant			30 09	94	
6	Hard Fr.	n w b.n 2		29 72	68		6		ſ.w b ſ. 3		29 88	98	
3. 12	Fair	W. 1		29 77	96		19. 12	Cloudy	S. W. 4		29 77	115	
9	Cloudy	W.byS.1	N. W.	29 78	96		9	Rain			29 60	103	
6	Cloudy	N.b.W.2	N. N. E.	29 82	93		6	Cloudy	ſ.w b.w 3		29 47	101	0 0
4. 12	Rain	N. 2		29 91	98		20. 12	Fair	W.b.S. 4	W. S. W.	29 54	118	
9	Cloudy	N. 2		30 02	90	0 02	9	Cloudy		1	29 48	100	
6	Froſt	N. W. 0	N.	30 11	79		6	Fair	S. W. 3	W. b. S.	29 38	99	
5. 12	Cloudy	N.byE. 1	N.byW.	30 15	94		21. 12						
9	Fairer	N.b.W.0		30 19	77		9	Rain			29 49	96	0 2
6	Hard Fr.	N.n.w.0		30 11	65		6	Hoar Fr.	W.ſ w. 1		29 50	82	
6. 12	Fair	E. 1	N. by E.	30 07	96		22. 12	Fair	S. W. 2	W.	29 53	113	
9	Cloudy	S. b. E. 0		29 95	87		9	Cloudy			29 53	96	
6		S. E. 1	S. by E.	29 82	82		6		S. b. E. 3	S. b. W.	29 40	101	
7. 12	Fair	S.e.b.ſ. 2	S. E.	29 83	107		23. 12	Rain	S. 3		29 32	118	
9	Cloudy			29 88	80		9				29 23	113	0 6
6			N.E.b.e.	29 97	82		6	Cloudy	S.b.W. 2	S. S. W.	29 07	100	0 5
8. 12	Fair	E.S.E. 0		30 05			24. 12	Fair	S. 4		29 06	119	
9		E.b.N. 2		30 11	85		9	Thunder			29 01	100	
6	Froſt	N. E. 0		30 12	8		6	Rain	S. W. 3	W.	29 19	99	0 5
9. 12	and	E.N.E. 2		30 13	98		25. 12	Cloudy	W. 2		29 31	117	
9	Cloudy			30 14	87		9	Fair			29 38	94	
6		N.byE.0	E.	30 10	85		6	Hoar Fro.	S. W. 0		29 39	82	
10. 12	Cloudy	N.byE.1		30 11	103		26. 12	Fair	S.b.W. 2		29 41	117	
9				30 08	91		9	Rain			29 46	92	0
6	Small	E.byN.0		30 00	86		6	Fair	S. 0	W.S.W.	29 48	86	
11. 12	Rain	S.byW.2	S.	29 97	102		27. 12	Rain and	S. 0		29 50	121	
9				29 93	92	0 41	9	Hail			29 54	98	0
6		S. 1		29 84	93	0 18	6	Rain	S. S. E. 0		29 63	92	
12. 12	Cloudy	S.byW.1		29 84	106		28. 12		N.N.w.1		29 71		
9				29 78	97		9						
6	Rain	S.byW.1		29 63	93	0 01	6	Fair					
13. 12		S.byE. 1		29 58	102		29. 12	Rain					
9	Fairer			29 69	88	1 68	9	Fair			29 33	96	0
6	Froſt	W. 0		29 80	81		6	Cloudy	W.b.S. 1	W.	29 30	93	
14. 12	Fair						30. 12		W.S.w.3		29 23	112	
9	Cloudy			30 84	108		9	Fair			29 20	96	
6		ſ.w.b.ſ. 2	W. by S.	29 87	107		6	Cloudy	W.n.w.4		29 20	99	0
15. 12	Cloudy						31. 12	Fair	N.n.w.6		29 29	102	
9				30 02	116		9	Rain	N. W. 2		29 43	96	
6	Cloudy	S. W. 1	W.S.W.	30 04	112						Total		5
16. 12	Fair	S. W. 2		30 02	127								
9	Cloudy			29 99	110								

APRIL, 1699.

D.	h.	Weather.	Winds.	Clouds.	Barom.	Ther.	Rain.
	6	Rain	W. b. N. 1	N. W.	29 37	93	
1.	12	and	N. 4		29 39	102	
	9	Hail			29 52	98	0 27
	6		N N.w. 3		29 50	92	
2.	12	Same	N. 2		29 53	102	
	9		N. b. E. 2	N. E.	29 61	95	0 14
	6		N. 2	N.e.b. n.	29 63	88	
3.	12	Cloudy	*N. e b. n.* 3		29 67	108	
	9		N. b. E. 3	N.e.b.n.	29 79	93	
	6	Fairer	N. b. E. 3	N. E.	29 85	90	
4.	12	Day	N. E. 4		29 90	107	
	9		N. b. E. 2		29 91	86	
	6	Froſt and	N. b. E. 2		29 83	82	
5.	12	Fair	N. E. 2		29 75	109	
	9	Cloudy			29 69	95	
	6		E. b. N. 0	N.	29 55	92	
6.	12	Cloudy	E. S. E. 1	S.	29 46	112	
	9				29 43	95	
	6	Cloudy	S. e. b. e. 1	S. E.	29 37	85	
7.	12	Cold	E. 2		29 36		
	9	Fair			29 28	98	
	6	Cloudy	N. 2		29 17	98	
8.	12	withſome	N. b. W. 1		29 21	103	
	9	Drops			29 17	98	
	6	Cloudy	S. 0	N. W.	29 13	97	
9.	12		S. 1	S. W.	29 15	115	
	9	Rain			29 16	97	0 52
	6	Fair	S. b. W. 0	S. W.	29 23	93	
10.	12		S. 1		29 31	124	
	9	Cloudy			29 43	104	
	6		N. 1		29 46	99	
11.	12	Rain	N. 3	N. N. E.	29 48		
	9				29 52	101	0 07
	6		N. E. 3		29 59	103	0 35
12.	12	Cloudy	N. E. 4		29 70	113	
	9				29 83	99	
	6	Cloudy			29 90		
13.	12	Fair	N. E.				
	9	Cloudy			29 86	97	
	6	Cloudy	*N.e.b.e.* 3		29 82	104	
4.	12	Fair	E. N. E. 3	E.	29 83	121	
	9	Rain			29 76	108	0 12
	6	Cloudy	*N.e.b.n.* 3	E.	29 64	105	0 05
5.	12	Rain	S. W. 1	S. W.	29 61	118	
	9	Fairer			29 61	101	0 97
	6	Cloudy	S. b. W. 1		29 58	101	
6.	12		S. 1		29 50	129	
	9	Fair			29 36	103	
	6	Rain	W.S.w. 3		29 21	103	
17.	12						
	9	Fair			29 25	99	0 21
	6	Hoar Fr.	S. W. 1		29 34	85	
18.	12	Fair					
	9	Rain	S. 1		29 34	100	
	6	Fairer	E. 2		29 28	103	0 02
19.	12		W.b.N. 1		29 42	125	
	9	Cloudy			29 65	110	
	6	Hoar Fr.	W. 0		29 72	89	
20.	12	Fair					
	9				29 84	115	
	6	Mild	S.S.W. 1	S. W.	29 87	110	
21.	12	warm &	S. W. 2		29 94	81	
	9	Fair			29 98	115	
	6	Cloudy	W.S.w. 0	W.	29 99	97	
22.	12		W.b.S. 2		29 00	130	
	9	Fairer			29 97	110	
	6	Fair	S.w.b.w. 2		29 96	104	
23.	12	and	W.S.W. 3	N. W.	29 97	131	
	9	Pleaſant			29 88	113	
	6		S. S. W. 3	W.S.W.	29 74	109	
24.	12	Fair					
	9				29 60	110	
	6	Fair	S.w.b.w. 3	W.	29 64	102	
25.	12						
	9	Rain			29 37	105	
	6	Fair	S w.b.w. 4	W.	29 12	109	0 71
26.	12		W. 4		29 15	123	
	9	Cloudy			29 14	100	
	6	Fair	S. W. 1		29 23	91	
27.	12	Rain	W. b. S. 1		29 31	124	
	9	Cloudy			29 41	105	0 01
	6	Fair	W.b.N. 1	N. b. W.	29 52	89	
28.	12	Drops of	N. 2		29 64	122	
	9	Rain	E. 1	E. b. N.	29 77	101	
	6	Hoar Fr	N. E. 0		29 81	92	
29.	12	Fair	E. 1	N. b. E.	29 81	129	
	9	Cloudy	E. 0		29 79	104	
	6	Cloudy	E. 0	N. b. W.	29 78	96	
30.	12	Fair	S. b. W. 1	n.w. b.w.	29 79	135	
	9	Cloudy	N.e.b.n. 0		29 81	117	
					Total		3 44

MAY, 1699.

D. h	Weather.	Winds.	Clouds.	Barom.	Ther.	Rain.	D. h	Weather.	Winds.	Clouds.	Barom.	Ther.	Rain.
6		W. by S. 1	N. W.	29 24	118		6		E. N. E. 3		29 76	113	
1. 12	Fair	N. W. 1			138		17. 12	Cloudy	N.e.b.e. 3		29 72	137	
9							9				29 71	113	
6	Fair						6	Fair	N.e.b.n. 2		29 69	115	
2. 12	Dry						18. 12	and hot					
9	Rain	S. by W. 3		29 65	113		9	Day			29 77	124	
6	Cloudy	S.w.b.w. 2		29 47	120	0 34	6		N. 2	N. b. E.	29 80	113	
3. 12		W.S.W. 3		29 38	133		19. 12	Fair	N.e.b.e. 3		29 83	146	
9	Showers	W. 3		29 35	106	0 19	9		E. b. S. 0		29 86	115	
6	Fair	S. b. W. 1		29 34	105		6		N. E. 2		29 86	110	
4. 12							20. 12	Same	E. by S. 2		29 86	143	
9	Rain			29 11	99	0 88	9				29 83	110	
6	Fair	W. by S. 2		29 17	90		6	Cloudy	N N.E. 1		29 80	112	
5. 12	Thunder	S. W. 1		29 31	118		21. 12	Hot and	E. by N. 2		29 76	148	
9	Rain			29 40	98	0 29	9	Fair	N. E. 3		29 75	120	
6	Hoar Fr.	S. S. W. 1		29 51	92	0 00	6	Fair	N. E. 2		29 72	112	
6. 12	Fair	S. W. 3		29 58	121		22. 12	Hot and					
9	Showers			29 69	107	0 01	9	Dry			29 66	115	
6		S. by W. 0		29 79	98		6	Cloudy	N.e.b.n. 1	N. b. E.	29 66	109	
7. 12	Fair	S. by E. 2	S.	29 81	137		23. 12		E. 1	N.	29 59	134	
9				30 87	108		9	Fair	E. 1	W.	29 49	145	
6		S. 1		29 90	102		6	Rain	N.N.E. 3	N. b. E.	29 43	117	
8. 12	Fair	S. 2		29 93	143		24. 12					113	
9							9	Fair			29 50	106	0 0
6	Fair						6	Fair	N.N.W. 2	N. b. W.	29 53	102	
9. 12	and						25. 12	Hail	N. by W. 3		29 55	120	
9	Rain	E. 1		29 93	115		9	Fair	E. by S. 0		29 57	107	0 6
6		N. E. 1		29 90	92		6	Fair	E. by S. 1	N. b. W.	29 55	104	
10. 12	Same	N. b. E. 1		29 88	147		26. 12	Rain	S. W. 2	W. by S.	29 57	132	
9				29 92	118		9	Fairer	W. 0		29 62	113	0
6		N. by E. 3		30 00	117		6	Fair	S. W. 1		29 65	109	
11. 12	Same	N. 2		30 10	150		27. 12	Cloudy	S. W. 1	S.	29 67	140	
9				30 21	108		9	Fair	S. 0		29 66	118	
6	Fair	N. by W. 2		30 17	105		6	Fair	E. 1	S. E.	29 61	122	
12. 12	and	N. 4		30 14	132		28. 12	Sultry	E. 2	S.	29 57	150	
9	Dry			30 10	108		9	Rain	E. 0	E. S. E.	29 58	131	
6		N. b. E. 3		30 10	110		6		E. 0	N. W.	29 63	124	0
13. 12	Same	N. N. E. 4		30 08	137		29. 12						
9				30 09	109		9						
6	Cloudy	N. N. E. 2		30 05	110		6						
14. 12		N. b. E. 2		30 02	130		30. 12						
9	Fair	E. 1	N. N. E.	30 01	112		9						
6		E. N. E. 1	N. E.	29 99	110		6	Hot and					
15. 12	Same						31. 12	Dry					
9				29 92	100		9		W. b. S. 2		30 08	114	
6	Cloudy	N.e.b.e. 2	E. N. E.	29 88	108						Total		2
16. 12	Fair	E. N. E 3		29 87	131								
9	Cloudy			29 83	110								

JUNE, 1699.

D.	h.	Weather.	Winds.	Clouds.	Barom.		Ther.	Rain.
	6	Very	S. W. 2	W. b. S.	30	08	132	
1.	12	dry, hot						
	9	Day			30	00	138	
	6	Fair	S.w.b.ſ. 0	S.w.byS.	29	91	132	
2.	12							
	9	Rain			29	85	134	0 01
	6		W. 2		29	90	123	
3.	12							
	9							
	6							
4.	12							
	9							
	6							
5.	12							
	9							0 01
	6	Fair						
6.	12	and						
	9	Dry	W.by .2		29	72	120	
	6		W.by S. 3	W.by N.	29	78	121	
7.	12		W. 2		29	82	142	
	c							
	6							
8.	12							
	9							
	6	Great						
9.	12	Drought						
	9							
	6	Cloudy		N. W.				
10.	12		W.byN. 2	W.by N.	29	67	146	0 53
	9	Fair	W. 0		29	73	125	
	6	Fair	W.byS. 1		29	79	126	
1.	12	Hot						
	9	Cloudy	E. 0		29	87	128	
	6	Hot and	E. 1	W. by S.	29	86	138	
2.	12	very						
	9	Dry	E. by S. 0		29	81	136	
	6	Fair	E. 1		29	76	131	
.	12		E. by S. 1	S.E.by S.	29	71	158	
	9	Rain	S. 1	S. by E.	29	70	138	0 04
	6		S. S. W. 3		29	86	126	
	12		S.by W. 4	S.w.by ſ.	29	92	154	
	9							
	6							
.	12							
	9							
	6							
.	12							
	9							

D.	h.	Weather.	Winds.	Clouds.	Barom.		Ther.	Rain
	6							
17.	12							
	9							
	6							
18.	12							
	9							
	6							
19.	12							
	9							
	6	Some						
20.	12	Cloudy	W.N.W.1		29	88	148	3 6
	9	Some F.	W.N.W.0	N.w.b.n.	29	92	128	
	6		W. 0	N.N.W.	29	95	130	
21.	12		S. 1	N. W.	29	98	163	
	9							
	6							
22.	12							
	9							
	6	Fair						
23.	12	Hot	S. E. 1		29	93	165	
	9	Day			29	93	141	
	6	Fair	S. E. 1		29	94	140	
24.	12	Sultry	N.byW. 1	W.	29	94	165	
	9	Rain	E. 1		29	93	140	0. 2
	6	Fair	E. 0	W.byN.	29	89	140	
25.	12	Hot	W.by S. 1		29	87	166	
	9	Day	S.w.b.w.2		29	82	144	
	6		W. 2	W.by N.	29	76	142	
26.	12	Fair						
	9		N. W. 2		29	84	134	
	6		N. W. 2	N.w.b.n.	29	98	130	
27.	12	Same	S. 2	W.	30	01	158	
	9				29	96	135	
	6		W.S.W. 2	W.	29	90	133	
28.	12	Same	W.N.W.2	W.	29	91	161	
	9				29	92	125	
	6		W.N.W.2		29	96	118	
29.	12	Same	W.by S. 1		29	99	143	
	9				29	99	135	
	6		n.w.b.w. 1	N. W.	29	99	135	
30.	12	Same	n.w.b.w. 3		29	97	162	
	9		E. 1	N.	29	97	130	
					Total.			4 40

JULY, 1699.

h.	Weather.	Winds.	Clouds.	Barom.	Ther.	Rain.
6	Misling	N.e.b.e 1		30 00	134	
12	Hot and	E. S. E. 2		30 00	150	
9	Fair			29 97	122	
6	Fair	E. S. E. 1		29 96	125	
12	and	N. E. 2		29 92	150	
9	Hot			29 87	124	
6		E. 1		29 83	131	
12	Same	E. 2		29 82	157	
9				29 78	129	
6	Fair	E. b. N. 1		29 74	120	
12	Cloudy					
9	Fair	N.e.b.n. 1		29 80	135	
6	Fair	N. 2		29 85	123	
12		N. 2	N. N. E.	29 87	150	
9	Cloudy			29 90	125	
6		N. b. E.		29 90	120	
12	Cloudy	N. N. E. 2		29 90	143	
9				29 86	115	
6		N.e.b.n. 0	E. b. N.	29 84	120	
12	Fair	E. 1		29 81	147	
9				29 78	125	
6	Fair	E. by S. 1		29 79	110	
12	and	W.n.w. 1	W. b. N.	29 82	165	
9	Hot	N.w.b.n. 0		29 90	143	
6		N. b. W. 1		30 01	152	
12	Same	n.w.b.w. 1	N. W.	30 03	153	
9				30 04	131	
6				30 01	119	
0. 12	Same					
9		W.		29 88	147	
6	Hot and	W. by S. 2		29 89	140	
1. 12	Dry	W.b.N. 2	N. W.	29 89	162	
9				29 92	143	
6	Sultry	E. by N. 0		29 97	140	
12. 12	Hot	E. N. E. 1		29 97	178	
9	Cloudy			29 97	143	
6	Very	E. by S. 0		29 96	133	
13. 12	Hot and	E. S. E. 1	S. b. E.	29 97	173	
9	Dry			29 90	142	
6	Sultry	E. 1		29 87	136	
14. 12	Rain &	E. by S. 2	E. b. N.	29 88	164	
9	Thunder			29 91	139	0 64
6	Cloudy	N.e.b.n. 2		29 93	136	
15. 12	Fair and	N. E. 3		29 90	164	
9	Dry			29 87	136	
6	Fair	N. E. 2		29 87	140	
16. 12	Hot and	E. 2	N. E.	29 88	172	
9	Dry			29 89	134	

D. h.	Weather.	Winds.	Clouds.	Barom.	Ther.	Rain.
6		E by N. 0		29 91	138	
17. 12	Same	E. by N. 2		29 93	167	
9				29 99	131	
6	Cloudy	N. by E. 3		30 03	130	
18. 12	Cool	N. 2		30 06	142	
9	Day			30 06	127	
6		N. 2		30 01	126	
19. 12	Same	N. 1		29 98	138	
9	Rain.			29 92	123	
6	Cloudy	N.N.w. 1		29 86	115	
20. 12	and	N.w.b.n. 2		29 86	139	
9	Cool			29 86	126	0
6	Cloudy	N.N.w. 1		29 87	126	
21. 12		N.N.w. 1	N. N. E.	29 87	155	
9	Fair	S. 1		29 83	134	
6	Fair	W. by S. 1		29 81	122	
22. 12		N. W. 1		29 80	159	
9	Cloudy	S. E. 0		29 78	135	
6	Fair	S. E. 1		29 78	131	
23. 12	Some	S. 2		29 74	172	
9	Drops			29 73	139	
6	Fair	S. W. 1		29 71	128	
24. 12	Rain	S. W. 2	W.	29 67	160	
9	Fair			29 58	129	0
6		S. S. E. 1		29 37	129	
25. 12	Rain		S.	29 21		
9		S. 1		29 17	129	1 8
6	Fairer	S. 1	S. W.	29 21	118	
26. 12	Rain		S. S. W.	29 24	156	
9	Fair	S. 2		29 25	129	0
6		S. by W. 2	S.W.b.ſ.	29 11	128	
27. 12	Same	S. 4	S. S. W.		153	
9				29 18	128	0
6	Fair	S. 1		29 24	125	
28. 12		S. W. 4	S. S. W.	29 27	147	
9	Rain			29 28	129	0
6	Fair	S. by W. 3		29 30	129	
29. 12	Rain	S.w.b.ſ. 4	S. W.	29 29	148	
9	Thunder			29 35	124	2
6		S.w.b ſ. 3	S. W.	29 38	122	
30. 12	Fairer	S. W. 4		29 42	149	
9				29 46	128	
6	Rain	S. S. E. 1	S. by W.	29 36	126	1
31. 12		S. 4		29 34	144	
9	Fair			29 36	127	
				Total		6

AUGUST, 1699.

D.	h.	Weather.	Winds.	Clouds.	Barom.	Ther.	Rain.
	6	Fair	S. by W. 4	S. S. W.	29 32	128	
1.	12	Rain	S.w.b.ſ. 4		29 33	14	
	9	Cloudy	S. W. 8		29 36	130	0 07
	6	Fair	W. by S. 1		29 62	118	
2.	12		W.S.W. 1	W. by S.	29 70	147	
	9	Cloudy			29 63	131	
	6	Cloudy	N.N.W. 1	W. S.W.	29 56	123	
3.	12						
	9	Fair			29 72	117	
	6	Cloudy	N N W. 0	W. by S	29 75	105	
4.	12	Fair	E. by S. 2	W. by N.	29 71	147	
	9	Rain			29 50	12	
	6	Rain	E by S. 0	S.w.by ſ.	29 37	125	1 38
5.	12		S. W. 1	W.	29 31	139	
	9	Fairer			29 63	127	0 46
	6		S. 0		29 67	125	
6.	12	Showery	S. 2		29 59	139	
	9				29 50	130	0 08
	6	Fairer	S. W. 4		29 39		
7.	12						
	9	Rain			29 32	126	
	6	Fair	S. W. 4		29 30	118	0 75
8.	12		S. W. 3		29 33	141	
	9	Rain			29 55	117	0 66
	6		S. W. 2	W. S.W.	29 63	116	
9.	12	Fairer	S.w.b.w. 3		29 66	145	
	9				29 69	125	
	6	Fair	S.w.b.ſ. 3		29 70	119	
10.	12		S. W. 3		29 72	150	
	9	Cloudy			29 72	131	
	6	Fair	S. 1	S. S. W.	29 65	116	
11.	12		S. 3		29 58	152	
	9	Cloudy			29 43	137	
	6	Rain	N. W. 1	W. by S.	29 49	117	
12.	12	Fair	W. by N. 3		29 57	140	
	9				29 65	120	0 44
	6	Cloudy	S. S. W. 3	N. W.	29 67	120	
13.	12						
	9	Rain			29 65	132	
	6	Cloudy	S. W. 2		29 61	131	0 17
14.	12		W. by S. 2	N. W.	29 69	153	
	9	Fair			29 73	134	
	6	Fair	W. S.W. 2	W. by S.	29 75	139	
15.	12		W.S.W. 3		29 72	158	
	9	Rain			29 75	122	0 44
	6		N. W. 1		29 87	110	
16.	12	Fair	N.w.b.n. 2		29 98	132	
	9				30 00	111	
	6	Fair	N.N.W. 1		29 98	108	
17.	12						
	9	Cloudy			30 00	116	
	6		N. by W. 1		30 01	110	
18.	12	Cloudy	N. 2	N. N. E	30 03	138	
	9				30 02	115	
	6		N. 2		29 97	116	
19.	12	Cloudy	N. by E. 2	N. N. E.	29 92	142	
	9				29 87	124	
	6	Cloudy	E. N. E. 1		29 82	119	
20.	12	Fairer	N.e.b.n. 2		29 80	140	
	9	Cloudy			29 76	127	
	6		N. E. 1	N.e.b.n.	29 70	117	
21.	12	Fairer					
	9				29 56	129	
	6	Mist	N.N.E. 0		29 50	126	
22.	12		W. by N. 1		29 53	150	
	9	Fair			29 59	122	
	6	Misty	S. by W. 0	S.	29 63	118	
23.	12	Fair	S. 2		29 64		
	9	Cloudy			29 56	128	
	6	Rain	S. 1	S. by W.	29 47	129	0 24
24.	12	Cloudy	S. by W. 3		29 43	148	
	9	Rain			29 37	127	0 21
	6	Cloudy	S. W. 1	W.	29 41	119	
25.	12		S. W. 3		29 53	149	
	9	Fair			29 64	124	
	6	Fair	S. W. 1	W. by S.	29 71	116	
26.	12		S. by E. 2		29 68	137	
	9	Rain			29 63	136	0 58
	6	Fair	S.w.b.ſ. 2		29 67	120	
27.	12		S.w.b.ſ. 3		29 65	143	
	9	Cloudy	S. 4	S. S. W.	29 45	128	
	6		S. W. 5	S.w b.w.	29 48	118	
28.	12	Fair	W. by S. 5	W.N.W.	29 59	140	
	9		W.S.W. 1	W.	29 80	117	
	6	Fair	S. W. 0	W.	29 86	112	
29.	12						
	9	Rain	S. W. 1		29 89	129	0 12
	6		S. S. W. 2	S. W.	29 89	121	
30.	12	Fair	S. S. W. 2	S.	29 85	150	
	9				29 78	121	
	6	Fair	E. 1		29 60	115	0 01
31.	12						
	9	Rain	W. 2		29 73	129	
					Total		8 57

SEPTEMBER, 1699.

D.	h.	Weather.	Winds.	Clouds.	Barom.	Ther.	Rain.
	6	Miſty	S. W. 0		29 84	98	
1.	12		S.w.b.ſ. 2	S.	29 85	145	
	9	Fair	S. 0		29 80	122	
	6		S. E. 0	S. by E.	29 77	112	
2.	12	Cloudy					
	9				29 77	130	
	6		S. S. E. 0	S.	29 67	122	
3.	12	Same	N. W. 2	n.w.b.n.	29 65	144	
	9				29 72	120	
	6		N.e.b.n. 1	S. S. E.	29 90	108	
4.	12	Fair	N. 2	N. by W.	29 18	138	
	9				30 12	115	
	6	Miſty	N. 0	E.	30 17	96	
5.	12		E. 1		30 18	39	
	9	Fairer			30 15	112	
	6	Miſty	E. 0		30 07	92	
6.	12		E. S. E. 1	E.	30 03	142	
	9	Fair			30 01	115	
	6	Miſty	E. 0		30 03	97	
7.	12	Fair	N. E. 2	N. N. E.	30 06	147	
	9	Cloudy			30 15	131	
	6	Miſling	N. by E. 2		30 21	123	
8.	12	Fair	E. N. E. 3	N. E.	30 22	137	
	9	Cloudy			30 22	121	
	6		N. 1	N.e.b.n.	30 18	116	
9.	12	Fair					
	9				30 12	115	
	6		E. 0		30 10	97	
10.	12	Fair	E. 2		30 08	142	
	9				30 05	121	
	6	Miſt	E. 0		29 95	110	
11.	12		E. 1		29 94	150	
	9	Fair			29 91	121	
	6		E. 0		29 89	102	
12.	12	Same	E. 1		29 90	152	
	9				29 90	127	
	6	Miſty	E. 0		29 91	114	
13.	12	ſomewh.	E. by N. 1	E.	29 93	143	
	9	Cloudy			29 93	120	
	6	Miſty	E. 0		29 89	126	
14.	12	leſs					
	9	Cloudy			29 89	134	
	6		S. W. 1	S.w.b.w.	29 91	122	
15.	12	Same					
	9	Very dry			29 93	134	
	6	Rain	S.w.b.ſ. 0		29 92	128	
16.	12		S. S. W. 1		29 92	140	
	9	Cloudy			29 81	122	0 15

D.	h.	Weather	Winds.	Clouds.	Barom.	Ther.	Rain.
	6		E. 0		29 59	112	
17.	12	Rain	S. W. 1		29 50	141	
	9				29 60	116	2 3
	6		W. by S. 2	N. W.	29 82	102	
18.	12	Fair	W. n. w. 2		29 88		
	9				29 91	106	
	6	Rain	S. S. W. 2	W.	29 80	115	
19.	12						
	9	Cloudy			29 65	130	0 1
	6	Rain	S. by W. 3		29 41	127	
20.	12		S.w.b.ſ. 4	S. by W.	29 42	125	
	9	Cloudy			29 36	115	0 3
	6	Fair	W. S. W. 3		29 44	106	
21.	12	Cloudy	S. by W. 4	W.	29 46	132	
	9	Rain			29 38	116	0 1
	6	Fairer	S. W. 3		29 14	112	2 5
22.	12	Rain	S w.b.w. 4		29 21	128	
	9	Stormy			29 21	116	1 1
	6	Fair	S. W. 3		29 05	103	0 2
23.	12	Cloudy	S.w.b.ſ. 9		29 07	122	
	9	Rain			29 95	102	
	6	Fairer	W. by S. 2	N.N.W.	29 08	100	0 7
24.	12		W. by S. 3	W. by N.	29 25	121	
	9	Rain			29 51	100	1 0
	6		W. by S. 1		29 75	88	
25.	12	Fair					
	9				30 00	101	
	6	Miſling	S. W. 1		30 04	102	0 0
26.	12		N.N.W. 1	N. by W.	30 10	120	
	9	Cloudy	N. by W. 0		30 18	121	
	6		E. S. E. 0	E. N. E.	30 21	112	
27.	12	Fair	E. by S. 2		30 23	123	
	9				30 23	101	
	6	Fair	N. by W. 1		30 16	100	
28.	12	Small	N. by E. 2		30 12	130	
	9	Rain			30 08	117	
	6		E. 0	E. N. E.	30 12	117	
29.	12	Fair	E. by N. 2		30 12	135	
	9		E. N. E. 3		33 11	123	0
	6		E. by N. 3		30 08	122	
30.	12	Cloudy	E. 3	E. by N.	30 10	127	
	9		E. by N. 3		30 08	120	
					Total		8

OCTOBER, 1699.

D.	h.	Weather	Winds.	Clouds.	Barom.	Ther.	Rain.
	6	Fairer	E. by N. 1	E.	29 97	122	
1.	12		E. 2		29 93	132	
	9	Cloudy			29 92	123	
	6	Rain	E, by N. 2		29 87	118	
2.	12	Fairer	E. by N. 1		29 80	131	
	9	Rain			29 73	111	1 45
	6	Fairer	E. by S. 1	S. S. W.	29 68	115	1 92
3.	12	Cloudy	S. W. 2		29 67	128	
	9				29 73	118	
	6		S. W. 0		29 79	108	
4.	12						
	9						
	6	Cloudy					
5.	12						
	9	Fair			29 98	96	
	6	Hoar Fr.	N.N.W. 1		30 12	87	
6.	12	and	N. 1		30 17	112	
	9	Fair			30 22	89	
	6		N. W. 0		30 18	99	
7.	12	Cloudy	W.byN. 1		30 19		
	9	Rain			30 20	96	
	6		N.e.b.n. 1		30 21	105	0 07
8.	12	Cloudy	E. by N. 1		30 20	119	
	9				30 16	110	
	6		E. 0		30 07	106	
9.	12	Same	E. by N. 2		30 06	119	
	9				30 01	99	
	6	Miſt	E. by N. 0		29 92	92	
10.	12						
	9	Fair			29 85	104	
	6	Miſt	E. 1		29 80	99	
11.	12	Cloudy					
	9	Miſling			29 80	120	
	6	Miſt	S.e.b.e. 0		29 75	109	0 40
12.	12	Warm	S. 2		29 77	140	
	9	Fair			29 79	115	
	6	Cloudy	S. 0	S. by W.	29 77	106	
13.	12	and	S.w.b.ſ. 3		29 79	136	
	9	Warm			29 87	119	
	6		S. by E. 2		29 78	119	
14.	12	Same	S. 2		29 81	133	
	9				29 65	122	
	6	Cloudy	S. 3	S. S. W.	29 57	129	
15.	12	Miſling	S. 2		29 57	136	
	9	Rain			29 54	127	
	6		E. S. E. 2	S.E.by S.	29 52	122	
16.	12	Rain	S. E. 1	S. by E.	29 48	130	
	9				29 50	122	0 64
	6		E. 1	S. E.	29 59	117	
17.	12	Fair	E. 1	S. E.byE.	29 56	130	
	9				29 61	111	
	6		N. E. 2		29 65	118	
18.	12	Cloudy	E. by N. 1		29 65		
	9				29 66	110	
	6		N. E. 2		29 68	116	
19.	12	Same	E. by N. 3		29 71	83	
	9				29 74	114	
	6	Cloudy	E. 3		29 75	111	
20.	12	and	E. by N. 3		29 80	111	
	9	Cool			29 85	93	
	6		E. 1		29 89	79	
21.	12	Firſt Ice	E. 3		29 92	120	
	9				29 93	83	
	6	Froſt	S. 0		29 91	73	
22.	12	and	E. by S. 1		29 91	98	
	9	Fair			29 87	79	
	6		E. 0		29 77	70	
23.	12	Same	E. by S. 2	E.	29 77	101	
	9				29 70	82	
	6	Cloudy	E. 1	S. W.	29 51	85	
24.	12		S. E. 3	S.W.b.S.	29 32	111	
	9	Rain			29 07	109	1 95
	6	Fair	S. W. 3		29 18	94	1 04
25.	12	Cloudy					
	9	Rain			29 16	96	
	6		W. 1	N.w.b.n.	29 18	92	0 90
26.	12	Fair	N.byW. 3	N. W.	29 32	110	
	9		W.N.W. 0		29 51	88	
	6	Froſt	W.S.W. 0		29 51	82	
27.	12		S. 3		29 42	117	
	9	Cloudy	S. W. 1		29 43	111	
	6	Cloudy	S. W. 0		29 51	100	
28.	12		S.w.b.ſ. 1		29 51	114	
	9	Rain	E. S. E. 2		29 28	110	1 24
	6		S. 3		29 08	117	0 31
29.	12	Rain	S. S. E. 2	S.	29 03	122	
	9		W.N.W. 3		29 16	96	0 43
	6		S.w.b.w. 2		29 48	89	
30.	12	Fair			29		
	9				29 48	100	
	6	Cloudy	S. 4	S. W.	29 36	115	3 12
31.	12				29		
	9	Rain			29 14	113	
					Total		13 49

NOVEMBER, 1699.

D.	h.	Weather.	Winds.	Clouds.	Barom.	Ther.	Rain.
	8		W. 3	W. S.W.	29 29	95	
1.	12	Fair	W.byN. 4		29 42	103	
	9	Rain			29 67	99	
	8		S.w.b.w. 0	W. by S.	29 80	106	0 28
2.	12	Fair	S. by W. 2	S. W.	29 85	116	
	9	Cloudy			29 84	109	
	8	Fairer	S. 3		29 53	105	
3.	12		S. 6	S. by W.	29 52	115	
	9	Rain			29 60	102	0 36
	8		S. W. 3	W.S.W.	29 85	96	
4.	12	Fairer			29 92	112	
	9				29 96	111	
	8	Fair	S. W. 3	N.N.W.	29 98	107	
5.	12	Cloudy	S. W. 2	W.	30 01	120	
	9	Fair			30 03	112	
	8		S. S. E. 0		30 02	100	
6.	12	Fair	S. S. E. 1	S.	30 02	115	
	9				29 97	97	
	8	Miſty	S. S. W. 2		30 02	110	
7.	12						
	9	Fair			30 22	94	
	8		W. 0		30 27	84	
8.	12	Miſty	W. 1		30 27	98	
	9				30 30	101	
	8		S. by E. 1		30 29	100	
9.	12	Cloudy	S. E. 1		30 28	107	
	9				30 22	87	
	8	Froſt and	E. 1		30 16	80	
10.	12	Fair	E. 1		30 18	103	
	9				30 27	92	
	8		N. 0		30 31	87	
11.	12	Foggy	N. by E. 0		30 30	101	
	9				30 33	96	
	8	Miſty	E. N. E. 0	S. w. b. ſ.	30 30	94	
12.	12		E. by N. 0	S.w. b.w.	30 30	104	
	9	Cloudy			30 23	103	
	8	Cloudy	S. W. 1	W. byN.	30 09	103	
13.	12	Fair	S. W. 3		30 03	110	
	9	Cloudy			29 85	102	
	8	Fair	W.S.W. 1		29 76	103	0 20
14.	12		W.S.W. 4	N. W.	29 70	110	
	9	Stormy	W.S.W. 8		29 36	114	
	8	Cloudy	W. 6	N. W.	29 53	109	
15.	12		W.byN. 5	N. W.	29 63	115	
	9	Fair			29 84	94	
	8		W. by S. 1	W. n. w.	29 87	89	
16.	12	Fair	W.S.W. 2	W.	29 88	105	
	9				29 80	113	

D.	h.	Weather.	Winds.	Clouds.	Barom.	Ther.	Rain.
	8		N. W. 3	W.	29 86	103	
17.	12	Fair	W. 1		29 93	105	
	9				29 91	85	
	8	Froſt	W.S.W. 3		29 81	92	
18.	12		W.S.W. 3		29 87	107	
	9	Fair			29 94	94	
	8	Froſt	S. byW. 0	N. W.	29 94	79	
19.	12	and	S. 1		29 94	97	
	9	Fair			29 91	92	
	8		S. 1	S. W.	29 85	88	
20.	12	Same	S.w.b.ſ. 2		29 85	106	
	9				29 86	109	
	8	Cloudy	S.w.b.ſ. 2	W.S.W.	29 84	112	0 0
21.	12	Mild	S.w.b.ſ. 3	W. b. S.	29 82	122	
	9	Fair			29 78	112	
	8	Rain	W. 0	N.w.b w.	29 75	103	0 4
22.	12	Fair	N. 1		29 83		
	9				29 89	85	
	8	Froſt	N. W. 0	N. by E.	29 89	80	
23.	12	and	N. W. 0		29 90	91	
	9	Fair			29 92	75	
	8	Froſt	N. W. 0		29 86	71	
24.	12	and	N. W. 1		29 85	90	
	9	Cloudy	S. W. 1		29 83	95	
	8	Cloudy	S. W. 0		29 76	89	
25.	12						
	9						
	8						
26.	12	Rain					
	9						
	8	Froſt					
27.	12	and					
	9	Fair					
	8						
28.	12	Hard Fr.					
	9						
	8						
29.	12	Snow					
	9		N. by E. 2				
	8	Snow					
30.	12						
	9	Fairer			29 60	60	0
					Total		1 9

DECEMBER, 1699.

D.	h.	Weather.	Winds.		Clouds.	Barom.		Ther.	Rain.	
	8	Cloudy	N.N.W.	o		29	71	73		
1.	12	Hard Fr.	N. W.	o		29	71	76		
	9	Fairer				29	58	60		
	8	Froſt	E. by S.	3		29	30	78		
2.	12	Cloudy	E.	4		29	12	82		
	9	Snow				28	91	83		
	8		E.	3		28	61	91	0	56
3.	12	Rain	E. by S.	3		28	52	94		
	9					28	44	100		
	8	Cloudy	E. S. E.	3	S. S. E.	28	60	98	0	18
4.	12	Fair								
	9	Rain				28	74	99		
	8		S. by E.	o	S. by W.	29	01	99	0	13
5.	12	Fair	S.	2	S. S. W.	29	14	110		
	9	Rain				29	28	103		
	8	Fair	S.	2		29	26	107	0	74
6.	12	Rain and	S by E.	3	S. by W.	29	32	115		
	9	Warm				29	39	108		
	8	Cloudy	S.	1		29	50	106	0	36
7.	12	and				29	48	112		
	9	Warm				29	48	105		
	8	Cloudy	S. S. E.	1	S. by E.	29	37	109		
8.	12	Miſling	S. S. E.	3		29	32	116		
	9	Warm				29	36	114		
	8		S. E.	3		29	19	113		
9.	12	Rain	S. S. E.	3		29	19	117		
	9					29	29	112	0	38
	8		S. by E.	1		29	41	102		
10.	12	Fair	S. by E.	2		29	46	112		
	9					29	57	98		
	8	Fair	S. W.	o		29	83	92	0	06
11.	12	Cloudy								
	9	Rain				29	95	108		
	8	Cloudy	S. by E.	2	S. by W.	29	84	109	0	36
12.	12	and ſome	S.	1	S. W.	29	78	115		
	9	Rain				29	73	108		
	8	Cloudy	S. W.	3		29	54	110	0	61
13.	12		S.w.b.w.	3		29	57	112		
	9	Fair				29	63	104		
	8		S. W.	1	W. by S.	29	51	102	0	21
14.	12	Rain	W. by S.	1		29	43	108		
	9					29	48	98		
	8	Fair	W. by N.	2	N.N.W.	29	64	100		
15.	12		N.N.W.	1		29	69	103		
	9	Cloudy				29	91	99		
	8	Miſling	N.N.W.	1		30	07	95		
16.	12		N.	1		30	14	101		
	9	Fair				30	27	87		
	8	Froſt and	N.	o		30	25	73		
17.	12	Fair	S. W.	1		30	20	88		
	9	Rain				30	33	90	0	29
	8	Froſt	N. W.	1		30	44	82		
18.	12	Hazy								
	9	Fair				30	35	76		
	8	Cloudy	W.	1	N. W.	30	21	81		
19.	12	with	N. W.	1		30	20	93		
	9	Thaw				30	23	91		
	8	Cloudy	N. W.	o	N.	30	26	86		
20.	12		N. W.	1		30	27	102		
	9	Fair	W.N.W.	o		30	31	94		
	8	Miſling	N. by W.	o		30	36	90		
21.	12		N. by E.	1		30	40	99		
	9	Fairer				30	47	94	0	03
	8	Miſling	N.	o	N. E.	30	50	89		
22.	12		N.	1		30	49	92		
	9	Cloudy				30	46	85	0	07
	8	Froſt	N. by W.	o		30	40	74		
23.	12	Fog	N.	o		30	38	88		
	9	Cloudy	S. by E.			30	15	86		
	8		S. W.	o		30	21	86		
24.	12	Cloudy	S.w.b.ſ.	2		30	19	94		
	9		S. S. W.	1		30	15	91		
	8	Fairer	S. S. W.	1		30	14	98		
25.	12		S.w.b.w.	1		30	12	102		
	9	Rain	S. by W.	1		29	98	102		
	8	Cloudy	W.	o	n.w.b.w.	29	96	107	0	68
26.	12		W.	1	N. W.	30	06	105		
	9	Fair				30	10	94		
	8		W. by S.	2	N.N.W.	29	95	80		
27.	12	Fair	N. W.	2		29	94	98		
	9		W. by N.	o	N. by W.	29	94	91		
	8	Fog	W. by N.	o		29	90	94		
28.	12	Miſling	W. by S.	o	n.w.b w.	29	86	108		
	9	Rain				29	80	106	0	2
	8		W. by N.	2		29	72	90	0	58
29.	12	Fair	N. W.	4		29	83	100		
	9					30	03	82		
	8	Froſt	S. W.	2		30	01	89		
30.	12	Cloudy	S. W.	3	W. by S.	29	96	104		
	9	Rain				29	94	105	0	24
	8	Fairer	S. W.	3		29	95	110	0	0
31.	12		S. W.	3		29	92	112		
	9	Cloudy				29	95	103		
						Total			5	77

In theſe Tables, I have never ſet down the *Flying of the Clouds*, but when they varied from the Winds; which oftentimes happens, eſpecially before the Wind ſhifteth its Courſe: Mountains, *&c.* may cauſe ſome Variation, but as little at *Upminſter*, as almoſt any where. This laſt Column will be neceſſary, amongſt other Uſes, to ſhew the Reaſon why the *Mercury* varies ſometimes: As ſuppoſe the Wind was in the Southerly Points, and the Clouds flew from the Northerly; the Riſing of the Mercury would be readily accounted for. N. 249. p. 46.

N. 262. p. 527. My *Thermometer* is graduated by Inches and decimal Parts. The Point of Freezing is about 80, or at moſt 82 Degrees, and conſequently 'tis cold at about 90, and temperate at about 100 Degrees. I need not ſay, that the Degrees above 100 are warm or hot; and thoſe below 80 are harder Froſts. The Degrees of my *Thermometer* reach to 240, although I could never make the Spirits deſcend with artificial Freezing, much lower than 50, neither when expoſed to the Heat of a pretty ſtrong Sun, did they aſcend above 225. It is placed in the open Air, and always defended from the Beams of the Sun. So that it ſheweth only the true preſent Temperature of the Air.

The Winter has been ſo mild (as appears by the *Thermometer*) that many of the Days of *November* and *December* were not much colder than many of the Mornings and Evenings of the warmer Months. Theſe two laſt Months have been alſo much drier than uſual, ſo that had it not been for the Rains of *October*, perhaps a Drought had been a general Calamity.

I have had frequent Confirmations of what I obſerved laſt Year, concerning the Mercury riſing in foggy Weather. The like it doth alſo in miſling Weather; as may be ſeen in divers Places of this Table: Particularly *December* 22, the Weather being miſling, and Wind Northerly, it aſcended to 30, 50 Inches, the higheſt I ever ſaw at *Upminſter*.

Hurricanes and Storms, by Mr. J. Temp'er, n. 71. p. 2156. XXVIII. 1. *October* 30, 1669. Between five and ſix of the Clock in the Evening, the Wind Weſterly, at *Aſhley* in *Northamptonſhire*, happen'd a formidable *Hurricane*, ſcarce bearing ſixty Yards in its Breadth, and ſpending itſelf in about ſeven Minutes of Time. Its firſt diſcerned Aſſault was upon a *Milk-maid*, taking her Pail and Hat from off her Head, and carrying her Pail many Scores of Yards from her, where it lay undiſcovered ſome Days. Next it ſtorm'd the Yard of one *Sprigg*, dwelling in *Weſthorp*, where it blew a Waggon-body off the *Axle-trees*, breaking the *Wheels* and *Axle-trees* in pieces, and blowing three of the *Wheels* ſo ſhatter'd over a Wall. This *Waggon* ſtood ſomewhat croſs to the Paſſage of the *Wind*. Another *Waggon* of Mr. *Saliſbury's* marched with great Speed upon its *Wheels* againſt the Side of his Houſe, to the Aſtoniſhment of the Inhabitants. A Branch of an *Aſh-tree*, of that Bigneſs, that two luſty Men could ſcarce lift it, blew over Mr. *Saliſbury's* Houſe without hurting it; and yet this Branch was torn from a Tree an hundred ~~Yards diſtant from that Houſe.~~ A Slate was forced upon a Window of the Houſe of *Sam. Templer*, Eſq; which very much bent an Iron Bar in it; and yet 'tis certain, that the neareſt Place the Slate was firſt forced from, was near 200 Yards. At Mr. *Maidwell's* Senior, it forced open a Door, breaking the Latch, and thence marching, through the *Entry*, and forcing open the Dairy-door, it over-turned the Milk-Veſſels, and blew out three Panes or Lights in the Window; next it mounted the *Chambers*, and blew out 9 *Lights* more. From thence it proceeded to the *Parſonage*, whoſe Roof it more than decimated; thence it croſſeth the narrow Street, and forcibly drives a Man headlong into the Doors of *Tho. Briggs*. Then it paſſed with a curſory Salute at *Tho. Marſton's*, down to Mr. *Geo. Wignil's*, at leaſt a *Furlong's* Diſtance from *Marſton's*, and two Furlongs from *Sprigg's*, where it play'd notorious Exploits, blowing a large Hovel of *Peaſe* from its Supporters, and ſetting it cleverly upon the Ground, without any conſiderable Damage to the Thatch. Here it blew a Gate-poſt, fix'd two Foot and an half in the Ground, out of the Earth, and carried it into the Fields many Yards from its firſt Abode.

About half a Mile diſtant from the Town is a ſmall *Wood* on the Top of an Hill, and partly deſcending into a Vale encompaſſed by Northerly and Southerly Hills; ſo that the Wind may ſeem confin'd to the Vale as a *Channel*, before it aſſaulted the Town, and thereby enforc'd to ſpend itſelf only in that *Glade*. But I am unapt to think, that ſome *Flatus* from the deſcending Wood-ground might contribute to this Accident, becauſe the Wind continued, ſo far as Men could judge, as high in the Field afterwards; and the Site of the Town did expoſe (by reaſon of thoſe Vallies) a far greater Part of the Town to this Damage than was troubled, the Valley being above four or five times the Breadth of that Part of the Town concerned in it.

2. *Oct.* 13, 1670. At *Braybrook* in *Northamptonſhire*, about eleven a Clock, the Wind, in a ſtrange Form, aſſaulted a Peaſe-Rick in the Field, uncovering the Thatch of it, and leaving another within twenty Yards unconcerned. Thence it proceeded to the Parſonage, where it carried not twelve, ſcarce eight Yards in Breadth, blowing up the End of a *Barley Rick*, and therewith ſome Stakes in it of near five Foot long. In the mean while it left a *Wheat-hovel* within ſix Yards of the *Barley-Rick*, and being without all Shelter, untouched, no Part of the Thatch of the *Hovel* being ſo much as furled. Nevertheleſs it beat down a *Jackdaw* from the Rick, with that Violence, as forc'd the Guts out of the Body, and made it bleed plentifully at the Mouth. This I ſaw, and took up, in ſome Company, the Daw very warm. Thence it went in a right Line to the Parſonage Houſe, took off the Cover of all the Houſe in its Compaſs. From hence it paſſed over the Town without any Damage, the reſt of the Town being low in Situation, and went on to a Place called *Forthill*, where it uncloathed ſo much of the Malt-houſe as lay within ir Line and Breadth, ſo as to expoſe the Malt upon the Floor to the open ur.

By Mr. J. Templer, ib. p. 2157.

raybrook ſtands in a Valley environed by Hills on three Sides, at three arters of a Mile's Diſtance from it. But (what I could chiefly obſerve) there n Hill call'd by the Name of *Clackhill*, within a Mile of it, and exactly in t Point of the *Compaſs* in which the Wind then ſtood; no Hill in its way the *Wind* had paſſed over all the Places it endamaged. And which is rerkable, there have been two Earthquakes in this Town within theſe ten

Years, when the then gentle Air (or Wind ſhall I call it) only vibrated upon that Point of the Compaſs.

By Sir Geo. Mackenzie, n. 124. p. 307.

3. *Dec.* 21. 1674. The *Wind* here (at *Tarbut*) was extraordinary: It broke a Standard-Stone, that ſtood as an *Obeliſk* near an old Church; which Stone was about twelve Foot high, five Foot broad, and near two Foot thick. Whole Woods were overturned, and torn up from the Root, though in a low Situation. It blew from the North-weſt, and of a long time the Wind had continued Weſterly.

By Mr. Scarsburgh, n. 231. p. 659.

4. *Oct.* 19. 1693. There happen'd a moſt violent Storm in *Virginia*, which ſtopped the Courſe of the ancient Channels, and made ſome where never were any: So that betwixt the Bounds of *Virginia* and *Newcaſtle* in *Penſylvania*, on the Sea-board Side, are many navigable Rivers for Sloops and ſmall Veſſels.

By . . . n. 212. p. 192.

5. *Aug.* 1, 1694. There happen'd here (at *Warrington* in *Northamptonſhire*) between One and Two a Clock, a very terrible *Whirlwind* amongſt the Shocks of Corn, in that Part of *Acrement Cloſe*, which is in the Poſſeſſion of Mr. *Holt*, and took up into the Air about 80 or 100 Shocks, carrying a great deal out of Sight; the reſt was ſcattered about the Field, or on the Tops of Houſes or Trees thereabouts. I have ſeen of the Corn which was carried a Mile diſtant from the Field; and it is reported by Perſons of good Credit, that ſome was carried four or five Miles diſtant. The *Whirlwind* continued in *Acrement Cloſe* full half an Hour: I myſelf, and ſeveral other Perſons, ſaw at leaſt three or four Waggon Loads of Corn all at once whirled about in the Air.

A Spout *at* Topſham, *near* Exeter, *by Mr.* Z. Maine, n. 215. p. 18.

XXIX. Theſe Appearances are frequent abroad, but very ſeldom or never ſeen before with us, tho' ſome pretend to have ſeen of them in the *Downs*. The *French* call them *Trombs*, I ſuppoſe from the Figure and the Noiſe that they make, that Word ſignifying a Sort of a *Humming Top*. They are certain Elevations of Water during *Storms* and *Tempeſts*, reaching from the Superficies of the Sea to the Clouds. They happen ſeveral Ways; ſometimes the Water is ſeen to boil, and raiſe itſelf for a conſiderable Space round, about a Foot from the Surface, above which appears, as it were, a thick and black Smoak, in the Midſt of which is obſerved a Sort of Stream or Pipe reſembling a Tunnel, which ariſeth as high as the Clouds; at other Times theſe Pipes or Tunnels are obſerved to come from the Clouds, and ſuck up the Water with great Noiſe and Violence. They move from the Place where they were firſt gathered, according to the Motion of the *Wind*, and diſcharge themſelves ſometimes into the Sea, to the unavoidable Deſtruction of ſuch Ships as are in their Way, if they be ſmall Veſſels, and to their great Damage be they never ſo big: Sometimes on the Shore beating down all they meet with, and raiſing the Sand and Stones to a prodigious Height. 'Tis ſaid that Veſſels, that have any Force, uſually fire their Guns at them, loaden with a Bar of Iron; and if they be ſo happy as to ſtrike them, the Water is preſently ſeen to run out of them with a mighty Noiſe, but no further Miſchief.

One of theſe *Spouts* happened here, at *Topſham*, *Aug.* 7, 1694, between nine and ten of the Clock in the Forenoon: 'Twas then very near, if not quite

Low-Water, which is look'd on as a ſpecial Providence, ſince had it been High-Water, 'tis concluded its Strength would have been much greater, and its Conſequences more ſad. The Water that was neareſt ſeemed to fly hither and thither, as though it would fain make its Eſcape from it: Yet I cannot find, upon Enquiry, that the Channel was at all wholly dry. There was alſo ſome Wind, though not ſo violent as it had been before, or when the *Spout* or *Tromb* began to move; it went with the Wind (which was then at *W. N. W.*) like a dark Smoke.

Fig. 19.

The Marks +++ ſhew the River, *O* the *Spout*, *S* Mr. *Seaward*'s Houſe, which it gently touch'd with little Damage, blowing only off a few Tiles; *G*, Widow *Goldſworthy*'s Houſe, which it in Part uncovered, and took almoſt all the Thatch off her Garden Wall. It took off alſo an Apple-tree, which was no way decay'd, and between fifteen and ſixteen Inches about, within two or three Inches from the Ground, almoſt as exactly as any Saw could have done it, and carried it, as I judge, between twenty and thirty Foot from the Place where it grew, and that not forward in the Path that it took, but almoſt directly backward; which makes me conclude, that it had a double Motion; the one external from the Wind ſtrait forward, the other internal and circular, like the *Fly* of a *Jack*, which a Man may carry in his Hand, that will ſtrike any Thing either forward or backward as it meets with it. *H*, Mr. *Green*'s Houſe, which was for the moſt Part untiled. There were two Houſes more, *W*, *L*, very much damaged in their Coverings; yet Mr. *Moxam*'s, M. tho' it ſtood between them, and was much higher than either, had only two or three Quarries of Glaſs broken. *E E E E E*, ſhews the March of the Spout. *X*, Planks that were blown, ſome upright, ſome ſeveral Yards out of their Place. *D*, a Ship newly launched, of about one hundred Tuns, which was much ſhaken, but not hurt. *K*, a Maſt of near a Tun Weight, thrown out of its Place. *C*, an Anchor that was torn out of the Ground and carried ſeven or eight Foot with a Boat that was faſten'd to it, and blown up into the Air; that Boat was rent from the *Head* to the *Keel*. *B*, another new Boat blown about ſix Foot high, and turned upſide down. *F*, a Fiſher-boat with one Man in it, which was near the Place where the *Spout* was at firſt perceived, but through Mercy eſcaped. *P*, a Lane that goes from the River in which ſome Houſes ſuffered Damage, which ſhews that the *Spout* was divided in its March. 'Tis no ſmall Mercy that no Man, Woman, or Child received the leaſt Injury in their Perſons.

Prognoſticks of the Wind; by J. Gill, n. 26, p. 481.

XXX. 1. *John Gill* affirms, that he hath obſerved on ſeveral Occaſions, that being in a Calm, that Way which the Sea began to loom or move, the next Day the Wind was ſure to blow.

Prognoſticks of Hurricanes; by Capt. Langford, n. 246. p. 407.

2. It hath been the Cuſtom of our *Engliſh* and *French* Inhabitants of the *Caribbee Iſlands*, to ſend in, about the Month of *June*, to the native *Caribbees* of *Dominico* and St. *Vincent*, to know whether there would be any *Hurricanes* that Year; and about ten or twelve Days before the *Hurricane* came, they did conſtantly ſend them Word, and it very rarely or ſeldom failed. From one of theſe *Indians* (whom in 1657, I engaged by Civilities to remain with me ſeveral Years) I had the following Prognoſticks.

1. All Hurricanes come either on the Day of the Full, Change, or Quarter of the Moon.

2. If it will come on the Full-Moon, you being in the Change, then obſerve theſe Signs.

That Day you will ſee the Skies very turbulent, the Sun more red than at other Times, a great Calm, and the Hills clear of Clouds, or Fogs over them, which in the *Highlands* are ſeldom ſo. Likewiſe in Hollows, or Concaves of the Earth, or Wells, there will be a great Noiſe, as if you were in a great Storm, and at Night the Stars looking very big with Burs about them, and the North-weſt Sky very black and foul, the Sea ſmelling ſtronger than at other Times, as uſually it doth in great Storms; and ſometimes that Day, for an Hour or two, the Wind blows very hard Weſterly, out of its uſual Courſe.

On the Full of the Moon you have the ſame Signs, with a great Bur about the Moon, and many Times about the Sun.

The like Signs muſt be taken Notice of on the Quarter Days of the Moon, in the Months of *July*, *Auguſt*, and *September*; for the Hurricanes come in thoſe Months; the ſooneſt that I ever heard of was the twenty fifth of *July*, and the lateſt was the eighth of *September*: But the uſual Month they come in is *Auguſt*.

The Benefit I have had of foretelling theſe Hurricanes is, that whereas heretofore they were ſo dreadful, that all Ships were afraid to go to Sea, and did rather chuſe to ſtay in the Roads at Anchor, than to run the Hazard of the mercileſs Sea, altho' never Ship eſcaped at Anchor, but was caſt aſhore, many Times by the Violence of the Storm, ſome Veſſels having been caſt ſo far on the Shore, that when the Storm was over, they have been from twenty or thirty Yards dry from the Waſh of the Shore, and the Veſſels ſet whole; and by this Means the Lives of thoſe that were in thoſe Veſſels were ſaved: But I finding that if a Man keeps his Ship ſailable, with good Store of Ballaſts, his Ports well barr'd and calked, his Top-maſts down, and his Tops too if he have Time, his Yards a-port laced, or long Ships, keeping ſecure his Doors and Windows of his Ship, and ſhe will lie as well as in other Storms; and they may, having their Ships in a Readineſs, ſtay in the Road till the Storm begins, which is always firſt at North, ſo to the North-weſt, till it comes round to the South-eaſt, and then its Fury is over. So with the North Wind they may run away to the South, to get themſelves Sea-room for drift of the South-weſt Wind, where it blows very fiercely: By theſe Means I have, by God's Bleſſing, preſerved myſelf in two Hurricanes at Sea, and in three at Shore, in the Years 1657, 1658, 1660, 1665 and 1667; in thoſe at Sea I loſt not a Sail, Yard, or Maſt, they being two great Hurricanes. And in the Year 1667, I being on Shore at *Nevis*, there was a Hurricane on the nineteenth Day of *Auguſt*; and fourteen Days before I did take Notice of the foregoing Signs on a full Moon, and I acquainted Sir *John Berry*, who was Commander of his Majeſty's Ship *Coronation*, and ſeveral other Commanders there, who did make their Ships ready for the Sea; and in the Morning about four of the Clock, the Wind coming hard Northerly, they put to Sea; and by God's Bleſſing came all back in four or five Days Time ſafe to the Road again. On the Shore, being confident of the Hurricane's coming, I took ſuch Care before-hand to ſecure my Sugars and Goods in the Store-houſe, that when the Hurricane had carried away the Roof of the Houſe, all except one Hogſhead of Sugar remained ſafe.

The Reaſons and Cauſes of theſe violent Storms, according to my Judgment, may be theſe:

1. It is not unknown to all Men of Experience, that to the Southward of the *Tropick* there is conſtantly a *Trade-Wind*, or Eaſterly Wind, which goes from the North to the South-eaſt all the Year about; except where there are Reverſions of *Breezes*, and Inlets near the Land: So that when this Hurricane, or rather Whirlwind, comes in Oppoſition to the conſtant Trade-wind, then it pours down with that Force and Violence, that it exceeds all Storms of Wind in the World; for it takes Trees away by the Roots, and thoſe that are extraordinarily ſtrong rooted, it twiſts off in the Middle: In the Hurricane in 1667, at *Nevis*, I ſaw the high Mountain that was all green with Trees, left in moſt Places bare, and the Wood lying in ſuch a Condition, with half Trees, or Stumps, or Quarters, that one would think it almoſt incredible.

2. It is remarkable by all Men that have been in thoſe Parts where the Sun comes to a *Zenith*, that at his Approach towards the *Zenith*, there is always fair Weather; but at his Return to the Southwards, it occaſions off the North Parts of the *Equinoctial* generally much Rains and Storms, as *Tornado's*, and the like, which makes the Winds in the *Tornado's* to come on ſeveral Points. But before it comes, it calms the conſtant Eaſterly Winds; and when they are paſt, the Eaſterly Wind gathers Force again, and then the Weather clears up fair.

3. The Wind being generally betwixt the *Tropicks* Eaſterly, unleſs at ſuch Times as before declared, meeting with the Oppoſition of theſe *Hurricanes*, which come in a contrary Courſe to that *Trade-Wind*, doth cauſe this violent *Whirlwind*, on the Sun's leaving the *Zenith* of *Barbadoes*, and thoſe adjacent Iſlands; by which the Eaſterly Wind doth much decay of its Strength; and then the Weſt Wind, which is kept back by the Power of the Sun, doth with the greater Violence and Force pour down on thoſe Parts where it encroaches. And it is uſual in our ſailing from *Barbadoes*, or thoſe Iſlands, to the North for a Weſterly Wind, when we begin to loſe our Eaſterly Wind, to have it calm, as it is before *Hurricanes*: And then the Wind ſpringing up, cauſeth it, till it comes well ſettled, to be various; but after the ſettled Weſterly Wind comes freſh, we have been conſtantly without thoſe Shufflings from Point to Point.

Here it is to be obſerved, that all *Hurricanes* begin from the North to the Weſtward, and on thoſe Points that the Eaſterly Wind doth moſt violently blow, doth the *Hurricane* blow moſt fiercely againſt it; for from the *N. N. E.* to the *E. S. E.* the Eaſterly Wind bloweth freſheſt; ſo doth the *W. N. W.* to the *S. S. W.* in the *Hurricane* blow moſt violent; and when it comes back to the *S. E.* which is the common Courſe of the *Trade Wind*, then it ceaſeth of its Violence, and ſo breaks up. So, with Submiſſion to better Judgments, I take the Cauſe of *Hurricanes* to be the Sun's leaving the *Zenith* of thoſe Parts towards the South. And Secondly, the Reverſe or Rebounding back of the Wind, which is occaſioned by the calming of the *Trade Wind.*

But it will be objected, Why ſhould not this Storm be all over thoſe Parts of the *Weſt-Indies*, as well as *Barbadoes* and the *Leeward Iſlands?* To which I anſwer, That it hath, in about twenty five Years of my Experience, taken its Courſe from *Bermudas* or *Summer-Iſlands*, to the *Caribbee Iſlands*; but ſeldom or never doth it carry ſuch a Breadth, as from the Latitude of 16 to 32 Degrees, which are the Latitudes of the one and the other Place; but it hath been obſerved, that when *Hurricanes* have been in *Martinico*, which is within two Degrees of Latitude, and two Degrees of Longitude, according to the Miles of that Circle, yet no *Hurricane* hath been in *Barbadoes*; nor could I ever call any of the former Storms at *Barbadoes*, *Hurricanes*, till that in 1675. Again, it hath been noted, that *Hurricanes* have done the like to the Northwards: For when the *Hurricane* hath been in *Antegoa* and St. *Chriſtopher*'s, thoſe Ships that were but in the Latitude of twenty Degrees, had no *Hurricane*, but conſtant Weſterly Winds reaſonably fair, and then there were no *Hurricanes* in *Bermudas*; and when the *Hurricanes* were at *Bermudas*, the *Leeward* or *Caribbee-Iſlands* had no *Hurricane*; nor had thoſe Iſlands the *Hurricane* when *Barbadoes* had it.

It may well be further objected, Why the *Hurricane* was never known to go farther to the Weſtward than *Porto Rico*, which lies in or near the Latitude of thoſe Iſlands of St. *Chriſtopher*'s? To this I anſwer, That from *Porto Rico* downwards, both that Iſland as well as *Hiſpaniola*, and other Iſlands there adjacent, are of vaſt Greatneſs, and very high Lands, that of themſelves do moſt commonly give Reverſal or Weſterly Winds at Night, through the Year: For there, for the Reaſons aforeſaid, the Eaſterly Wind towards Night doth calm, and thoſe Lands afford a *Land Wind*, which the other Iſlands cannot do, by Reaſon of the Smallneſs of thoſe *Carribbe-Iſlands*, but very near the Shore, the *Trade-Wind* having its full Power till this general *Whirl-wind* comes, for the Reaſons aforeſaid.

I do imagine ſo likewiſe to the Southwards of *Barbadoes*; where the *Tornadoes* come frequently, there are no *Hurricanes*; neither was there at *Barbadoes*, when theſe *Tornadoes* did commonly come there, which made ſome ſmall Reverſal, though it was but for two or three Hours: Yet the Eaſterly Wind, giving ſome way by the Sun's declining from that *Zenith*, doth prevent this furious Reverſe, where it hath no Vent, till by the Violence of the two *Winds* it is forced.

An Experiment of the Evaporation of Water; by *Mr.* Edm. Halley, n. 189. p. 366.

XXXI. We took a Pan of *Water* (ſalted to the ſame Degree as is common *Sea-Water*, by the Solution of about a fortieth Part of Salt) about four Inches deep, and 7 Inches $\frac{9}{10}$ Diameter, in which we placed a *Thermometer*, and by Means of a Pan of Coals, we brought the *Water* to the ſame Degree of Heat which is obſerved to be that of the Air in our hotteſt Summers; the *Thermometer*

meter nicely ſhewing it. This done, we affixed the Pan of *Water*, with the *Thermometer* in it, to one End of the Beam of the Scales, and exactly counterpoiſed it with Weights in the other Scale; and by the Application or Removal of the Pan of Coals, we found it very eaſy to maintain the *Water* in the ſame Degree of Heat preciſely. Doing thus, we found the Weight of the *Water* ſenſibly to decreaſe; and at the End of two Hours we obſerved, that there wanted half an Ounce *Troy*, all but 7 Grains, or 233 Grains of *Water*, which in that Time had gone off in Vapour; tho' one could hardly perceive it ſmoak, and the *Water* were not ſenſibly warm. This Quantity in ſo ſhort a Time ſeemed very conſiderable, being little leſs than 6 Ounces in 24 Hours, from ſo ſmall a Surface as a Circle of 8 Inches Diameter. To reduce this Experiment to an exact *Calculus*, and determine the Thickneſs of the Skin of *Water* that had ſo evaporated. I aſſume the Experiment alledged by Dr. *Edw. Barnard* to have been made in the *Oxford Society*, viz. that the Cube Foot *Engliſh* of *Water* weighs exactly 76 Pounds *Troy*; this divided by 1728, the Number of Inches in a Foot, will give $253\frac{1}{3}$ Grains, or half Ounce $13\frac{2}{3}$ Grains for the Weight of a Cube Inch of *Water*; wherefore the Weight of 233 Grains is $\frac{233}{253}$ or 35 Parts of 38 of a Cube Inch of *Water*. Now the Area of the Circle, whoſe Diameter is $7\frac{9}{10}$ Inches, is 49 ſquare Inches; by which dividing the Quantity of *Water* evaporated, *viz.* $\frac{35}{38}$ of an Inch, the Quote $\frac{35}{1862}$ or $\frac{1}{53}$, ſhews that the Thickneſs of the *Water* evaporated was the 53d Part of an Inch: But we will ſuppoſe it only the 60th Part, for the Facility of Calculation. If therefore *Water*, as warm as the Air in Summer, exhales the Thickneſs of a 60th Part of an Inch in two Hours from its whole Surface; in 12 Hours it will exhale $\frac{1}{10}$ of an Inch; which Quantity will be found abundantly ſufficient to ſerve for all the Rains, Springs, and Dews, and account for the *Caſpian Sea's* being always at a Stand, neither waſting nor overflowing; as likewiſe for the Current ſaid to ſet always in, at the *Streights* of *Gibraltar*, though thoſe *Mediterranean Seas* receive ſo many, and ſo conſiderable Rivers.

To eſtimate the Quantity of *Water* ariſing in Vapour out of the Sea, I think I ought to conſider it only for the Time the Sun is up, for that the Dews return in the Night as much, if not more Vapours than are then emitted; and in Summer the Days being longer than twelve Hours, this Exceſs is balanced by the weaker Action of the Sun, eſpecially when riſing before the *Water* be warmed: So that if I allow $\frac{1}{10}$ of an Inch of the Surface of the Sea to be raiſed *per diem* in Vapours, it may not be an improbable Conjecture.

Upon this Suppoſition, every 10 ſquare Inches of the Surface of the *Water* yields in Vapour *per diem*, a Cube Inch of *Water*; and each ſquare Foot half a *Wine* Pint; every Space of 4 Foot Square, a Gallon; a Mile Square, 6914 Tons; a ſquare Degree, ſuppoſe of 69 *Engliſh* Miles, will evaporate 33 Millions of Tuns: And if the *Mediterranean* be eſtimated at 40 Degrees long and 4 broad, Allowances being made for the Places where it is broader by thoſe where it is narrower (and I am ſure I gueſs at the leaſt) there will be 160 ſquare Degrees of Sea; and conſequently the whole *Mediterranean* muſt loſe in Vapour, in a Summer's Day, at leaſt 5280 Millions of Tuns. And this Quantity of Vapour, though very great, is as little as can be concluded from the Experiment produced: And yet there remains another Cauſe, which cannot be reduced to the Rule, I mean the *Winds*, whereby the Surface of the *Water* is lick'd up ſomewhat faſter than it exhales by the Heat of the Sun; as is well known to thoſe that have conſidered thoſe drying *Winds* which blow ſometimes.

The *Mediterranean* receives theſe conſiderable Rivers; the *Iberus*, the *Rhone*, the *Tiber*, the *Po*, the *Danube*, the *Neiſter*, the *Boryſthenes*, the *Tanais*, and the *Nile*; all the reſt being of no great Note, and their Quantity of *Water* inconſiderable. We will ſuppoſe each of theſe nine Rivers to bring down ten Times as much Water as the River *Thames*, not that any of them is ſo great in Reality, but to comprehend with them all the ſmall Rivulets that fall into the Sea, which otherwiſe I know not how to allow for.

To calculate the Water of the *Thames*, I aſſume that at *Kingſton-Bridge*, where the Flood never reaches, and the Water always runs down, the Breadth of the Channel is 100 Yards, and its Depth 3, it being reduced to an Equality (in both which Suppoſitions I am ſure I take with the moſt.) Hence the Profile of the Water in this Place is 300 ſquare Yards: This multiplied by 48 Miles (which I allow the Water to run in 24 Hours, at 2 Miles in an Hour) or 84480 Yards, gives 25344000 Cubick Yards of Water to be evacuated every Day, that is, 2030000 Tons *per diem*; and I doubt not but in the Exceſs of my Meaſures of the Channel of the River, I have made more than ſufficient Allowance for the Waters of the *Brent*, the *Wandel*, the *Lea*, and *Darwent*, which are all worth Notice, that fall into the *Thames* below *Kingſton*.

Now if each of the aforeſaid nine Rivers yield ten Times as much Water as the *Thames* doth, 'twill follow that each of them yields but 203 Millions of Tons *per diem*, and the whole nine but 1827 Millions of Tons in a Day; which is but little more than $\frac{1}{3}$ of what is proved to be raiſed in Vapour out of the *Mediterranean* in twelve Hours Time.

The Evaporation of Water in a Cloſe Room at Greſham Coll. 1693. *by Mr.* Edm. Halley, n. 212. p. 183.

XXXII. In order to explain the Circulation of Vapour experimentally, I cauſed an Experiment of the Quantity of Vapours ariſing ſimply from the Warmth of the Water, without being expoſed either to Sun or Wind, to be made in *Greſham College*, which was performed with great Care and Accuracy, by Mr. *Hunt*, *Operator* to the *Royal Society*. Having added up into one Sum, the Evaporations of the whole Year, I find, that from a Surface, as near as could be meaſured of eight ſquare Inches, there did evaporate during the Year, 16292 Grains of Water, which is 64 Cube Inches of Water; and that divided by eight Inches, the Area of the Water's Surface, ſhows that the Depth of Water evaporated in one Year amounts to eight Inches. But this is much too little to anſwer to the Experiments of the *French*, who found that it rained nineteen Inches Water in a Year at *Paris*; or thoſe of Mr. *Townley*, who by a long continued Series of Obſervations, has ſufficiently proved, that in *Lan-*

caſhire, at the Foot of the Hills, there falls above forty Inches of Water in the Year's Time. Whence it is very obvious, that the Sun and Wind are much more the Cauſes of Evaporation, than any internal Heat or Agitation of the Water.

The ſame Obſervations do likewiſe ſhew an odd Quality in the Vapours of Water, which is that of adhering to the Surface that exhaled them, which they cloath, as it were, with a *Fleece* of vaporous Air, which once inveſting it, the Vapour riſes afterwards in much leſs Quantity: Which was ſhewed by the ſmall Quantity of Water that was loſt in twenty four Hours Time, when the Air was very ſtill from Wind, in Proportion to what went away when there blew a ſtrong Gale, although the Experiment were made in a Place as cloſe from the Wind as could be well contrived. For which Reaſon I do not at all doubt, that had the Experiment been made where the Wind had come freely, it would have carried away at leaſt three Times as much as we found, without the Aſſiſtance of the Sun, which might perhaps have doubled it.

By the ſame Experiment it likewiſe appears, that the Evaporations in *May*, *June*, *July*, and *Auguſt* (which are nearly equal) are about three Times as much as what evaporated in the four Months of *November*, *December*, *January* and *February*, which are likewiſe nearly equal, *March* and *April* anſwering nearly to *September* and *October*.

This *Fleece* of Vapour in ſtill Weather hanging on the Surface of the Water, is the Occaſion of very ſtrange Appearances, by the Refraction of the ſaid Vapours differing from that of the common Air, whereby every Thing appears raiſed, as Houſes like Steeples, Ships as on Land above the Water, and the Land raiſed, and, as it were, lifted from the Sea, and many Times ſeeming to overhang. And this may give a tolerable Account of what I have heard of ſeeing the Cattle at high Water Time, in the Iſle of *Dogs* from *Greenwich*, when none are to be ſeen at low Water (which ſome have endeavour'd to explain, by ſuppoſing the Iſle of *Dogs* to have been lifted, by the Tide coming under it.) But the evaporous Effluvia of Water having a greater Degree of Refraction than the common Air, may ſuffice to bring thoſe Beams down to the Eye, which when the Water is retired, and the Vapours ſubſided with it, paſs above; and conſequently the Objects ſeen at the one Time, may be conceived to diſappear at the other.

JANUARY,

JANUARY, 1693.				FEBRUARY, 1693.			
D.	Grains.	Ther.	Barometer. Weather.	D.	Grains.	Ther.	Barometer. Weather.
1	31½	5	29. 7 Froſt.	1	36	29	30. 0
2	21	14	29. 7 Some Rain.	2	27	26	30. 2
3	21	18	29. 7	3	33	25	30. 2
4	23½	8	29. 7	4	48	16	29. 9
5	23½	8	30. 1	5	39½	20	29. 9 Some Rain.
6	26½	1	30. 5 Froſt.	6	26	16	29. 9 Small Rain.
7	31	— 3	30. 5 Froſt.	7	26	17	29. 8
8	25	— 5	30. 4 Froſt.	8	28	11	29. 9 A Fog
9	23	— 3	30. 4 Froſt.	9	23	16	30. 0
10	18	0	30. 4	10	26	20	30. 0
11	18	0	30. 4	11	39	8	30. 0
12	18	— 0	30. 4	12	40	5	29. 8
13	22	— 6	30. 3 Froſt.	13	52	— 1	29. 4 High Wind.
14	20½	— 7	30. 3 Froſt.	14	35	6	29. 2
15	21½	—10	30. 3 Froſt.	15	35	11	29. 4 Some Rain.
16	24	—15	30. 4 Froſt.	16	24	20	29. 2 Rain.
17	18	—13	30. 3½ Froſt.	17	39	20	29. 5 Rain.
18	18	—11	30. 2 Froſt.	18	39	19	29. 8
19	14	—10	30. 1 Froſt.	19	35½	17	29. 7
20	14	— 3	29. 6	20	35½	16	29. 3
21	21	0	29. 9	21	35	17	29. 0 Rain.
22	18	2	29. 9	22	29	10	29. 2
23	18½	0	30. 0 Froſt.	23	35	5	29. 3
24	18½	— 3	30. 0 Froſt.	24	37	1	29. 2
25	14½	9	29. 9	25	35	— 5	29. 4
26	14½	14	29. 7	26	23½	— 8	29. 0 Snow.
27	20	17	29. 2	27	21	—11	29. 4 Snow.
28	36	10	29. 7	28	24	—14	29. 3 Froſt.
29	27½	15	29. 5 Some Rain.				
30	27½	15	29. 7				
31	27	27	29. 6				
	675 Gr.				690½ Gr.		

MARCH,

MARCH, 1693.				APRIL, 1693.			
D.	*Grains.*	*Ther.*	*Barometer. Weather.*	*D.*	*Grains.*	*Ther.*	*Barometer. Weather.*
1	25	—12	29. 2 Froſt.	1	32	15	29. 4
2	31½	—12	29. 1 Snow.	2	39	15	29. 5
3	28	—13	29. 3 Snow, Froſt.	3	37½	14	29. 7
4	28	—12	29. 6 Froſt.	4	37	23	29. 6½
5	28	— 8	29. 3 Froſt.	5	38	29	29. 2
6	20	— 1	29. 1	6	29	32	29. 2
7	35½	— 5	29. 3 Rain.	7	32	33	29. 3
8	39	9	29. 7	8	32	35	29. 4
9	42½	8	30. 0	9	28½	40	29. 2
10	39	14	30. 0	10	35	33	29. 4
11	33	21	30. 0	11	37	33	29. 4
12	42	21	29. 8	12	34	37	28. 9
13	42	22	29. 6½	13	39	32	29. 4
14	46	23	29. 4	14	39	33	29. 5
15	62½	14	29. 6	15	39	29	29. 7
16	41	19	29. 5	16	35	30	29. 8
17	42½	12	29. 4	17	37	31	29. 6½
18	50	10	28. 9	18	36½	36	29. 4
19	51½	7	29. 2	19	38½	36	29. 3½
20	45	8	29. 2	20	36	32	29. 3
21	41	7	29. 0	21	39	37	29. 2
22	50	8	29. 4	22	46	35	29. 4
23	37	10	29. 5	23	42½	35	29. 5
24	33½	6	29. 4	24	52	35	29. 2
25	27½	7	29. 3	25	50	35	29. 3½
26	30	11	29. 4	26	56	36	29. 7
27	57	9	29. 6	27	38	44	29. 5
28	38	4	29. 6	28	43	46	29. 7½
29	30	17	29. 5	29	40	49	29. 6
30	30	20	29. 4½	30	52	42	29. 9
31	20	24	29. 3				
	1166*G.*				1203 *G.*		

MAY, 1693.					JUNE, 1693.				
D.	*Grains.*	*Ther.*	*Barometer.*	*Weather.*	*D.*	*Grains.*	*Ther.*	*Barometer.*	*Weather.*
1	56	36	30. 1		1	78	65	29. 9	
2	61	26	30. 0		2	85	62	30. 0	
3	66	21	30. 1		3	95	54	30. 2	
4	61	19	30. 1		4	77	52	30. 1½	
5	52	31	30. 1		5	63	50	29. 9	
6	48	45	29. 8		6	49	60	29. 7½	
7	59½	35	29. 8		7	46	67	29. 7	
8	51	34	29. 7		8	63	63	29. 7	
9	51	31	29. 6		9	63	69	29. 8	
10	43	35	29. 5		10	63	63	29. 8	
11	49	30	29. 5		11	55	70	29. 8½	
12	54	32	29. 6		12	58	87	28. 8	
13	59	26	29. 7		13	59	75	29. 9	
14	59	32	29. 7½		14	86	72	29. 7	
15	46½	35	29. 7		15	63	79	29. 8	
16	46½	34	29. 8½		16	58	78	29. 9	
17	56	36	30. 1		17	86	79	30. 0	
18	70½	35	30. 3		18	81	66	30. 0	
19	58½	47	30. 1		19	92	57	30. 1	
20	76	50	30. 0		20	81	60	30. 0	
21	62	52	30. 1		21	80	71	29. 9	
22	73	64	30. 1		22	76	67	29. 8	
23	78½	64	30. 1		23	63	69	29. 7	
24	90	62	29. 9½		24	63	62	29. 6	
25	61	74	29. 9		25	57	65	29. 8	
26	67½	68	29. 9½		26	46	70	30. 0	
27	64	75	29. 9½		27	49½	68	30. 0	
28	71	67	30. 1		28	52	74	30. 0	
29	80	69	30. 2		29	59	68	30. 2	
30	89½	70	30. 2		30	62	69	30. 2	
31	106	68	29. 9						
	1968 *G.*					2008½ *G.*			

JULY, 1693.				AUGUST, 1693.			
D.	*Grains.*	*Ther.*	*Barometer. Weather.*	*D.*	*Grains.*	*Ther.*	*Barometer. Weather.*
1	75	67	30. 0	1	80	71	29. 5
2	75	67	30. 0	2	77	73	29. 6
3	63	62	30. 0	3	77	63	29. 8
4	62	61	30. 1	4	78	64	29. 9
5	60	63	30. 1	5	79	73	29. 9
6	74	65	30. 0	6	81	70	29. 9
7	61	65	30. 0	7	94	83	29. 6
8	51	65	30. 0	8	79	86	29. 6
9	46	74	29. 9	9	68	82	29. 7
10	52	77	29. 9	10	70	83	29. 8
11	72	74	29. 8	11	92	85	29. 8½
12	74	82	29. 4	12	70	80	30. 0
13	88	75	29. 7	13	81	73	29. 9
14	83	62	29. 9	14	68	75	29. 7
15	84	65	30. 1	15	69	74	29. 9
16	84	68	29. 8	16	77	72	29. 8
17	71	58	30. 1	17	77	77	29. 7
18	77	65	30. 2	18	84	77	29. 7
19	66	78	30. 1½	19	86	64	29. 5
20	71	78	30. 1	20	78	68	30. 0
21	72	82	30. 0	21	68	67	29. 7
22	90	74	30. 0	22	71	65	29. 7
23	99	68	30. 0	23	75	55	29. 9
24	85	71	30. 0	24	64	54	29. 5
25	85	81	29. 9	25	63	57	29. 5
26	94	75	29. 9½	26	58	59	29. 4
27	97	70	29. 8	27	60	55	29. 5
28	81	78	29. 7	28	53	55	29. 9
29	87	67	29. 9	29	53	58	29. 7
30	78	64	29. 9	30	53	56	29. 7
31	78	79	29. 3½	31	63	48	29. 7
	2335 *G.*				2246 *G.*		

SEPTEMBER, 1693.				OCTOBER, 1693.			
D.	*Grains.*	*Ther.*	*Barometer. Weather.*	*D.*	*Grains.*	*Ther.*	*Barometer. Weather.*
1	53	53	29. 7	1	40	35	29. 9
2	55	50	29. 6	2	57	41	29. 6
3	61	50	29. 7	3	41	35	29. 7
4	61	48	29. 7	4	27	49	29. 6
5	63	44	29. 8	5	29	48	30. 0
6	74	40	29. 7	6	31	49	30. 2
7	62	39	29. 6	7	29	58	30. 0
8	59	49	29. 5	8	37	60	30. 0
9	40	52	29. 5	9	39	59	30. 2
10	50	48	29. 6½	10	37	55	30. 1
11	46	41	29. 7	11	34	55	29. 9
12	48	43	29. 8	12	38	55	29. 8
13	46	53	29. 7	13	39	42	30. 0
14	43	57	29. 5	14	49	38	29. 8
15	46	70	29. 2	15	44	28	29. 7
16	49	54	29. 3	16	44	19	29. 7
17	46	52	29. 1	17	35	23	29. 1
18	52	45	29. 0	18	34	24	29. 2
19	48	45	29. 3	19	34	20	29. 2
20	50	44	29. 6	20	35	21	29. 5
21	43	42	29. 9	21	35	17	29. 9
22	41	51	29. 5	22	24	28	29. 7
23	46	45	29. 9	23	28	25	29. 7
24	44	52	29. 7	24	39	20	30. 0
25	41	47	29. 8	25	41	13	30. 0
26	43	47	29. 6	26	34	16	29. 9
27	46	45	29. 7	27	33	13	30. 0
28	47	40	29. 9	28	32	18	29. 8
29	50	44	29. 8	29	33	10	29. 8
30	40	42	29. 5	30	35	5	29. 7
				31	28	7	29. 4
	1495 *G.*				1095 *G.*		

NOVEMBER, 1693.					DECEMBER, 1693.				
D.	*Grains.*	*Ther.*	*Barometer.*	*Weather.*	*D.*	*Grains.*	*Ther.*	*Barometer.*	*Weather.*
1	18	22	29. 6		1	34½	—16	30. 0	Froſt.
2	15	30	29. 7		2	16¼	—10	30. 0	Rain.
3	24	34	29. 6		3	12	— 0	29. 9	
4	26	30	29. 7		4	12	7	29. 4	Some Rain.
5	33	21	29. 8		5	17½	10	22. 2	
6	33	10	29. 8		6	33	15	29. 4	Some Rain.
7	29	9	29. 7		7	19½	15	29. 1½	
8	20	23	29. 5		8	18	20	29. 0	R.&much Wet
9	21	21	29. 9		9	18	27	28. 6½	R. & Storm.
10	21	30	29. 7		10	25	16	28. 9	Some Rain.
11	32	27	29. 7		11	28¾	13	29. 6	
12	22½	34	29. 5		12	28	9	29. 5	
13	31	23	29. 4		13	25	14	29. 2	
14	25½	15	29. 9		14	15	20	29. 2	Some Rain.
15	27	10	29. 4		15	19	20	29. 5	
16	25½	3	29. 6		16	22½	15	29. 5	
17	26	— 7	29. 5		17	17½	20	29. 5	
18	21	— 1	29. 5	Great Fog.	18	21½	-10	30. 1	
19	21	— 2	29. 5	Great Fog.	19	22	3	30. 0	
20	19	2	29. 6		20	16	6	29. 8	
21	15	5	29. 8	Fog.	21	14½	9	29. 6	
22	11½	12	29. 7	Some Rain.	22	16½	14	29. 3	
23	20½	14	29. 7		23	22	11	28. 5	Stormy.
24	24½	8	29. 8		24	23	4	29. 0	
25	24½	5	29. 9		25	22	0	29. 5	Froſt.
26	33	—12	29. 9	Froſt.	26	22	5	29. 2	Rain.
27	33½	—12½	29. 9	Froſt.	27	16	10	29. 3	
28	27	—14	29. 8	Froſt.	28	20	6	29. 0	
29	42	—16	29. 8	Water	29	25½	0	29. 2	Froſt.
30	42	—17	29. 9	Frozen.	20	29½	5	28. 6	Stormy.
					31	24	7	29. 2	
	764 *Gr.*					646 *Gr.*			

Note, That in the Column of the *Thermometer*,—denotes Degrees of Cold below the freezing Point; and that from the tenth of *Nov.* to the End belong to the foregoing Year, 1692.

*The Changes of Weather from the Alterations of the Gravity of the At*moſphere; *by Dr.* Gorden, n. 171. p. 991.

XXXIII. 1. The *Air* agrees with all other *Fluids* in this, that it *gravitates*; and it has this peculiar Property (which is not ſo much obſerved of other *Fluids*) that its ſpecifical *Gravity* is not always the ſame. Now you know, according to the certain Rules of the *balancing* of *Fluids* amongſt themſelves, every *Fluid ſpecifically lighter* than another, will aſcend and emerge above it; and every *Fluid ſpecifically heavier* than another, will *deſcend* and *ſubſide* below. Now there is ſome certain *Proportion* between the *ſpecifical Gravities* of the *Fluid* of *Air*, and of that which aſcends in *Vapours*, and falls down again into *Rain*; and if this *Proportion* were ſtill the ſame, 'tis like we ſhould have no *Commixture* of thoſe *Fluids*, but the *Vapours* would either always *float* above, or always ſtay below. But this *Proportion* of their *ſpecifical Gravity* is frequently changed: For it's known that *Water*, when warm and tepid, is lighter than when it is cold; and the daily *Obſervations* of the different Heights of the *Mercury* in the *Baroſcope* do make appear, that the *Atmoſphere*'s Gravity is not always the ſame. And now from theſe known Properties may be eaſily deduced a ſtatical Account of the riſing of *Vapours*, their being carried in the Air in Clouds, and their falling down again into Rain. For if we may be allowed to ſuppoſe that when the *Atmoſphere* is heavieſt, there is ſome ſuch Proportion between its *ſpecifical Gravity*, and that of the Fluid of Vapours, as there is between *Water* and *Oil*; the Vapours, according to the known Laws of *Fluids*, muſt needs aſcend, and ſo long as this *Proportion* continues they muſt needs float above in the *Air*; but when the *Atmoſphere*'s *Gravity* is chang'd, the *Vapours* muſt fall down again.

I do not know any determinate Inſtrument that will indicate the *Aſcent* of Vapours, as certainly as the *Baroſcope* does the Change of the *Air*'s Weight, (for our common *Hygroſcopes* are not very exact, and beſides, I ſuppoſe their *Change* by Moiſture ſhews rather the falling than the riſing of Vapours) yet there are two or three Obſervations which ſeem certain *Indications* of their Aſcent: as firſt, if the *Horizon* and the remote Hills ſeems ſmoaky, and inconſpicuous, ſo that nothing can be ſeen at any Diſtance, and that, tho' the Heavens be not cloudy but clear, and tho' there be no Fog, nor yet any Cap of Clouds upon the Hills (which do rather indicate the falling of *Vapours*.) *Again*, if when you look to any diſtant Part of the Country, round about you, it appear all in an undulating Motion, this ſeems to be a Sign of the plentiful riſing of Vapours; for this is only occaſioned by looking through an unequal waving *Medium*, which makes frequent Inflections of the Beams of Light, as you ſee any Object ſeems to have a tremulating Motion in all its Parts when you look upon it through Smoke. Another Indication of the Aſcent of Vapours ſeems to be the copious riſing of Steams above Waters, Mariſh Grounds, and Fens; which is frequently ſeen in Froſts, and in cool Nights in Summer. To theſe I may add the Redneſs of the Sun (ſo as to be eaſily look'd upon) and Moon, a conſiderable Time before their ſetting, or after their riſing. Now ſince I have had Occaſion to make Obſervations of the *Baroſcope*, I have always taken notice of all theſe, when the *Mercury* was riſing, and conſequently in the *Increaſe* of the *Atmoſphere*'s Gravity: But on the contrary, when the *Mercury* has been low in the *Baroſcope*, and ſo the *Atmoſphere*'s *Gravity* leſs, I have obſerved none of theſe Effects, but the remote Hills were clear and diſtinct, (unleſs ſometimes a Cloud had fall'n down upon them) and no waving to be obſerved in the Air, nor Steams from the Waters. I know not whether I may add here a Conjecture about the great Light, and the *Capræ ſaltantes*, which are ſome Nights to be ſeen in the North. I have taken notice of them uſually when the *Mercury* has been high in the *Baroſcope*; and then they appearing in that Quarter of the Heavens where the Sun is at that Time below the *Horizon*, this has given me Occaſion to think, that perhaps the Steams of Vapours may have aſcended ſo far in the *Atmoſphere* as to be beyond the Earth's Shadow in that Part of the *Horizon*, and ſo by refracting the Beams of Light towards us, to occaſion that Light, and thoſe *Capræ ſaltantes*. It may be conſidered alſo whether the red Skies in the Evening, which betoken fair Weather, do not proceed from the Height of the Clouds, occaſioned at that Time by the Increaſe of the *ſpecifical Gravity* of the *Atmoſphere*.

Now as to the falling down of the Vapours again, it is viſible by their gathering into thick and dark Clouds, by the falling down of Clouds and Miſts on the Tops of Hills, and thick Fogs in the Air, and by their dropping down into Rain, Snow, *&c.* and that theſe do uſually fall out only when the *Mercury* ſubſides a little, and conſequently when the *Atmoſphere's* Gravity is leſs, is the conſtant Obſervation of thoſe who have had Occaſion to take notice of the Changes of the *Baroſcope*.

Againſt this it may be objected, that it is obſervable many times that even when the *Mercury* in the *Baroſcope* is riſing, there will be Rain, and particularly ſometimes in *North-Eaſt* Winds. To this I anſwer, That if the Clouds have been carried for ſome while towards one Quarter of the Heavens by the *Winds*, and then if the *Winds* do ſuddenly change into another Quarter, theſe *Vapours*, which were formerly ſcatter'd into ſmall Particles, and ſo did eaſily float, are ſuddenly driven together into little Drops, and ſo muſt needs fall down into *Rain*; and therefore the falling of *Rain* while the *Mercury* is riſing, is obſervable only upon the ſudden Change of contrary Winds.

But let us conſider, in the next Place, whether thoſe frequent *Commotions* in the *Air*, which we call *Winds*, may not be accounted for upon the ſame Principles. That known *Definition* of *Archimides* is univerſally acknowledged, *Quod earum partium minus preſſæ expellantur a magis preſſis*; ſo that if there be any Portion of a Fluid of a far leſs Preſſure and Reſiſtance than the reſt, the whole Fluid runs in a *Current* thither, till all be reduced to an *Æquilibrium*. Now it is evident that the Preſſure of the Air is not always the ſame, and 'tis very probable (which *Experience* will determine, by making joint *Obſervations* of the *Baroſcope* in ſeveral Places of the *Earth* at the ſame time) that the *Air's Gravity* is not alike chang'd throughout the whole *Atmoſphere* in an Inſtant. So that when the Air becomes *ſpecifically lighter* in one Place, or its Preſſure leſſened, the neighbouring Parts of the *Atmoſphere*, whoſe *Weight* is not thus leſſened, run thither in a Current, till the *Atmoſphere* thereabouts be reduc'd to an *Æquilibrium* again; and according to the Portion of Air thus changed, and the leſſen'd or acquir'd Degrees of the *Weight* and *Spring*, the Currents or Winds are ſtrong or weak, of a long or ſhort Continuance. Now Obſervation and Experience do agree with this, the *Mercury* being found to ſubſide for the moſt Part in the *Baroſcope* at the riſing of Winds; at leaſt it is obſerved to be in Motion, and either riſing or falling, and conſequently there is a Change in the *Atmoſphere*'s Preſſure at that Time.

But the great Difficulty remains ſtill, how to account for the different Changes of the *ſpecifick Gravity* of the *Atmoſphere.* Of this there can hardly be expected a ſatisfactory Account, till we come to know the Cauſe of Gravity in general, and of the Air's Weight in particular; and therefore I ſhall only here offer two or three Hints, which perhaps may incite others to conſider it more narrowly. And *firſt*, it is now almoſt generally acknowledged, that there muſt needs be a *Fluid* much more ſubtile than common *Air*, and of a far greater Preſſure than *Air*; which is the Cauſe of the Continuity and Coheſion of all terreſtrial Bodies, and in which the *Air* ſeems as it were to float, and to have the ſame Relation to it, as the Vapours do in, and have to the Air; and therefore if we could reach its Nature and Properties, it might be conſidered what Influence this may have upon the Change of the Air's Gravity. Or, *ſecondly*, ſeeing the Infuſion of one Liquor into another, in *Chymical Preparations*, will alter its *ſpecifical* Gravity, ſo that the Bodies which were formerly born up in it, will fall down and be precipitated; as the Particles of Gold floating thro' *Aqua Regis* will be precipitated by the Infuſion of another Chymical Liquor; it may be conſidered, whether Plenty of nitrous Steams, or ſome ſuch Mixture, may not alter the Air's *ſpecifical Gravity.* Or, *thirdly*, we may poſſibly come to a nearer Reſolution of this, by conſidering the Influence which the Heat and Cold have upon the Air's Spring. The Air you know has this peculiar Property, which is not ſo much obſerved of other Fluids; that it is endued with *Elaſticity* as well as *Gravity*; and therefore we are to conſider what Influence the Change of its *Spring* may have upon the Change of its Weight: and it ſeems evident, that the Increaſe of its Spring doth diminiſh its Weight, and the leſſening of its Spring will increaſe it; for upon the Increaſe of the Air's Spring, the Air is rarified, and ſo a leſſer Portion of it preſſes upon the ſubjacent Fluid: But when it is leſſened, the Air is condenſed, and ſo a greater Portion of it preſſes upon the ſubjacent Body. For Example, let us ſuppoſe the ſpringy Particles of Air to be like the ſpringy Hairs of Wool, or the Spring of a Watch; and that many Millions of Rows of them go to make up the Cylinder of Air, which, from the Top of the *Atmoſphere*, preſſes upon the *Mercury* in the *Baroſcope*, and keeps it ſuſpended to the Height of thirty *Inches*; let us ſuppoſe this Air rarified, ſo that all its ſpringy Particles expand themſelves, and therefore ſhut off of this Cylinder ſome thouſands of thoſe Rows; this Cylinder, being now made up of a far leſſer Number of thoſe Rows of Particles, muſt needs have a leſſer Preſſure upon the *Mercury*, ſo that it will ſubſide, perhaps, to twenty nine. And thus it continues till the Air's Spring be weakned, and ſo the Particles crowded again into narrower Room. Now if this be found to hold in the *Theory*, Experience ſeems very well to anſwer it: For I have hitherto obſerved, that in cold Weather, and ſharp Froſts, the *Mercury* riſes higheſt in the *Baroſcope*; and if the Foreign Meaſures agree with ours, it is uſually higher here than in *France* or *Italy*.

I ſhall here, after all, ſubjoin two or three Obſervations, which may ſerve to confirm what has been ſaid. The firſt is of the Courſe of the Weather under or near the *Line*. I have read in the ſecond and fourth Parts of *Purchas* his *Pilgrims*, (and I doubt not but later Travellers atteſt the ſame Truth) That, in *Braſil*, and *Guiana* in *America*; in *Guinea*, *Congo*, and *Ethiopia* in *Africa*; in the *Eaſt-Indies*, and the *Maldive* Iſlands; they have almoſt continual Floods of Rain from about the Beginning of *May* to the End of *Auguſt*, which they call their Winter, and the reſt of the Months of the Year fair and clear Weather, which they call their Summer: So that when the Sun is neareſt to them, they have conſtant Rains, and when remoteſt, fair Weather; and this I impute, amongſt other Cauſes, to the extraordinary Rarefaction of the Air, and leſſening of its *ſpecifical Gravity* there at that Time; ſo that the Vapours in the neighbouring Parts of the Air, do all flow thither, and deſcend, as it were in Floods of Rain. And as this is reckoned to be the Cauſe of the Inundation of the *Nile*, and ſome other Rivers, ſo perhaps this may be the Reaſon alſo, why thoſe Countries which are neighbouring to them, and ſomewhat remoter from the *Line*, ſuch as *Egypt*, and the like, have ſeldom or never any Rain.

My ſecond Obſervation is of the *Baroſcope*, *viz.* That when the Wind is North, North-eaſt, or North-weſt, the Mercury ever Riſes, and ſo the Air is heavier; but when the Wind comes from the South, South-eaſt, or South-weſt, it falls, and ſo the Air's Gravity is leſs: by which we may ſee what Influence the Cold and Heat have upon the Air's Weight; and you know a cold Wind is ſaid to drive the Sails of a Ship much more forcibly than a warm.

My third Obſervation is of an Experiment of the honourable Mr. *Boyle*. n.6.p.2048. I made, *ſaith he*, by Diſtillation a Blood-red Liquor, which chiefly conſiſted of ſuch ſaline ſpirituous Particles, as may be obtained from the Maſs of Blood in human Bodies. This Liquor is of ſuch a Nature, that if a Glaſs Viol, about half filled with it, be kept well ſtopt, the red Liquor will reſt as quietly as any ordinary one, without ſending up any Smoak; but if the Viol be unſtopt, ſo that the external Air be permitted to come in, within a quarter of a Minute or leſs, there will be elevated a copious white Smoak, which will not only fill the upper Part of the Glaſs, but plentifully paſs out into the open Air, till the Viol be again ſtopped. *And a little after he adds*, n. 171. p. 1000 If the unſtopt Viol were placed in our *Vacuum*, it would not emit any viſible Steams at all, nor ſo much as appear in the upper Part of the Glaſs that held the Liquor; whereas when the Air was by Degrees reſtor'd at the Stop-cock, the returning Air would preſently raiſe the Fumes, firſt into the vacant Part of the Viol, whence they would aſcend into the Capacity of the Receiver; and likewiſe when the Air that was requiſite to ſupport them, was pumped out, they alſo accompanied it, as their unpleaſant Smell evinced, and the red Spirit, tho' it remained unſtopped, emitted no more Fumes till the new Air was let in again. *So far he.* Such you ſee was the Proportion between the Gravity of the Vapours of this red Liquor and the Air, that the Air being in its ordinary Degree of Gravity, theſe Vapours did aſcend: but the Air's Gravity being much leſſened in the Receiver, by the pumping out a great deal of it, and ſo expanding the Spring of the reſt, it was not able to elevate thoſe Vapours.

By Dr. Wallis, ib. p. 1002.

2. That there is in our Air a Body more ſubtile than are the Fumes and Vapours mingled with it in our lower Region, and which, with it, do make up that heterogeneous Mixture, which we commonly call Air, I think to be very certain. But whether that ſubtile Body be (as Dr. *Gorden* ſeems to ſuppoſe) much heavier than our common Air, I much doubt; and do rather think it not, not having hitherto obſerved any cogent Experiment, either to prove it heavy or elaſtick: But it may, for ought I know, be void as well of Weight as Spring; and, what we find of either, in our common Air, may be attributed to the other Mixtures with it. For the Air being of a different Gravity, in different Times and Places (ariſing, I ſuppoſe, from the different Kinds and Quantities of the Fumes and Vapours, and other Particles, which are Ingredients in it, and the different Force of the Sun's Heat acting thereupon, increaſing or allaying the Spring thereof, and otherwiſe) we are therefore to conſider of the Air as a Fluid, whoſe Parts are in ſome Places heavier, and others lighter; and therefore much of a like Nature, as if they were different Fluids, of different *ſpecifick* or intenſive Gravity, one from the other.

Now when ſeveral Fluids, or ſeveral Parts of a Fluid, are thus of different Weights, they will (from the general Nature of heavy Fluids,) when undiſturbed, change Places with one another, till the heavier becomes loweſt, and the lighter higheſt.

And this not only as to the minuter Parts; it is obſerved in Chymical Precipitations, or the ſinking of Sand in Water, or its ſmaller earthly Particles, which ſubſide in a muddy Sediment, and the like of other Liquors when at reſt, and the Atoms (as they were wont to be called) flying in the Air when diſturbed, but ſubſiding in the Form of Duſt when at reſt, all which, according as they be ſmaller, do (*cæteris paribus*) ſubſide more ſlowly: But much more as to larger Parcels; as when Oyl, Wine, Water, Beer, or other the like Liquors, are put together in the ſame Veſſel, as will be obſervable to the Eye, eſpecially when their Colours are conſiderably different.

And the ſame will happen, if ſome Parts of the ſame Liquor, do accidentally acquire, by Expanſion, or otherwiſe, a greater Degree of Lightneſs than the other Parts; thoſe lightned Parts aſcending, the heavier ſubſide; as when Water, Beer, or other thin Fluids, be gradually heated by a Fire underneath, the lower Parts being Firſt warmed, aſcend to the Top, while the colder and heavier ſubſide; whence we find, in ſuch Caſes, that Bubbles do ariſe, and that at the Top is warmer than that at the Bottom: But in caſe what is warmed be of a thicker Conſiſtence, ſo as that the Parts cannot readily ſhift Places, that at the Bottom will be hotter; and in caſe it be heated by Fire over it, there will (I ſuppoſe) be no ſuch Bubbling, (or not ſo much of it,) that at the Top being firſt heated.

From ſuch Conſiderations as this, Dr. *Gorden* doth well obſerve, that ſome Parts of the Air being thus, by Rarefaction, or increaſing the Spring thereof, or otherwiſe, become lighter than others; theſe heavier Parts, ruſhing into the Places of thoſe lighter, may cauſe a Wind as from ſuch Parts; (in like manner as, on a like Occaſion, a Tide or Current would ariſe in Water;) and other Accidents of a like Nature. And contrariwiſe, on a contrary Occaſion.

And this I take to be true; though ſuch Accidents happening very variouſly and uncertainly, will cauſe ſuch Confuſion of Motions, and Diſturbance of each other, that it will be hard to reduce them to a regular Adjuſtment.

But I add thereunto, that the Earth's diurnal Motion compounded with its annual, (if we admit that *Hypotheſis*, as moſt do now-a-days) the one in ſome Parts accelerating, in others retarding the other; and its Difference in different Times of the Year, (by Reaſon of the Obliquity of the *Zodiack* to the *Æquinoctial*) and in different Times of the Month (becauſe of the Moon's different Poſition, which is an Appendance to the Earth's Motion, and doth thereby differently affect it) and, according to the different Place of the Earth and Moon, as to the *Aphelion* or *Perihelion* of the one, and the *Apogæum* or *Perigæum* of the other, ſeem to me to be of much greater Conſideration, not only as to the *Ebbing* and *Flowing* of the Sea, but as to the Winds alſo; eſpecially the *Breezes* and *Trade-Winds*, which at certain Times of the Day, of the Year, of the Month, are obſerved to blow conſtantly, or moſt frequently, from ſuch or ſuch a Coaſt.

And I am not ſure, that the Body of Earth and Water (or terraqueous Globe) is exactly ſpherical, allowing only for the ſmall Inequalities of Hills and Dales, which, in a Body of that Greatneſs are inconſiderable, but may have ſomewhat of an *Oblong Spheroid*, having a longer Axis from *Pole* to *Pole*, than at the *Æquator*. And tho' this cannot be much, becauſe of the Earth's Shadow in the Moon's Eclipſe appearing circular; and the Deſcent of heavy Bodies being always (as to Senſe) in a Perpendicular to the *Horizon*; yet if it be but little, this with the Compound Motions before mentioned, will give the Air a conſiderable Diſturbance.

To which I may add alſo, that we are not ſure that the Seas and Continents, which are of very different comparative Weights, Earth being heavier than Water, are ſo adequately adjuſted the one to the other, as that it Center of Gravity, by which a Plain paſſing divides it into Parts Æquiponderant, is the ſame with its Centre of Magnitude, by which it is divided into Parts equally great; which, if it happen to be otherwiſe, will with the reſt make the Confuſions of the Air's Motions yet greater.

From the comparative Weight or Lightneſs of the Air at different Times, he deduced alſo the riſing or falling of Vapours in it. As if when ſuch Fumes or Vapours, or other the like Matters are lighter than the Air, they ought, according to the exact Rules of *Hydroſtaticks*, to aſcend therein; but when heavier than ſo, to fall down. And this certainly (*cæteris paribus*) is to be admitted alſo. Only I add thereto, that theſe *ſtatick Principles* do chiefly take place, when Things are otherwiſe at Reſt and Quiet: But when they are in Commotion, it is many times much otherwiſe. And in ſuch Caſes, we muſt, beſides the reſpective Gravity, take into Conſideration the Force, Impulſe, or Impetus, that is ſuperadded to the reſpective Gravity of the Parts of Matter. Thus, if a Bottle be ſhaken, the Sediment at the Bottom, tho' heavier, and for which Cauſe it did before ſubſide, will be mingled with the ſupernatant (finer and lighter) Liquor. And if a Room be ſwept, it will, as we uſe to ſpeak, make a Duſt, that is, the ſmall earthy

Particles of Duſt will riſe and mingle with the Air, not becauſe they be lighter than it, for we ſee that at Leiſure they will ſubſide again; but becauſe by a Force upon them they be put into Motion. And this I take to be the Cauſe of Fumes, Vapours, and other like Matters, (moſt of them) which aſcend in the Air, not becauſe lighter than it, but becauſe impell'd upward out of the Bowels of the Earth, or from the ſuperficial Parts of it, either by ſome ſubterranean Heats, or other Ferments, that put them into Motion, and force them upward, where they remain ſuſpended in the Air, ſo long as that Force continues, or the Force of others ſent after them on the like Errand, which rather impels them farther, than gives them leave to fall, till either ſuch Force abate, or the great Weight of ſo many Things ſuſpended doth over-power, not only the Air's Weight, but the Strength of that that impelled them. And that there are ſuch Fumes, and other like Matter projected upwards from the Bowels of the Earth, and ſome of them with great violence, is undeniable, not only from Earthquakes and other Eruptions, with great Noiſes, as well of Vapours as of burning Mountains, but even poiſonous Steams, and others, in Mines and bubbling Springs, where Bubbles of Air are ſeen to make their Paſſage through the Water, and other Perſpirations of Air or Vapour, through Cranies, or ſmall Paſſages of the Earth, diſcoverable by Steams, whereof ſome will take Fire at the Light of a Candle, or by the moving of Leaves, and other light Things laid on the Mouths of ſuch private Paſſages, and by many other Means. And to ſuch Cauſes I do principally attribute the *Origin* of *Winds*, and the Aſcent of moſt other Things, which, from this lower World, mount into the Air: and without this, the comparative Gravity of the Air and them, would give us but a lame Account of them.

There is yet another Notion ſuggeſted, which is alſo very conſiderable as to this Affair, which is the weakning or ſtrengthning the Spring of the Air. That Water hath, of it ſelf, nothing of Spring or Elaſticity, otherwiſe than by reaſon of ſome airy Parts, or other elaſtick Bodies, which may be included within it, is generally held; at leaſt none conſiderable, ſuch as by any Experiments hitherto made, can be clearly evinced ſo to be. But that the Air, (ſuch Air, at leaſt, as is the common Air which we are converſant with) is elaſtick, is, I think, out of doubt: the Experiments which prove its Spring being ſo many and evident, beyond Exception. And that this Spring of the Air is ſometimes ſtronger, and ſometimes weaker, I think, is undoubted alſo; and that the Spring of the Air is ſtrengthned both by Compreſſion and by Heat, but in a different Manner. If the ſame Quantity of Air be compreſſed into a leſſer Room, the Spring is certainly ſtronger, as is undoubtedly ſeen in the Wind-Gun, and other compreſſive Engines. And the ſame Quantity of included Air in a cloſe Veſſel, ſo as not to communicate with the external Air, will by Application of Heat to it, have its Spring ſtrengthned, and drive its Counterpoiſe farther off, or if need be, compreſs it, as is to be ſeen in *Thermoſcopes* of all ſorts.

If the Spring be ſtrengthned by Compreſſion, it is manifeſt that the intenſive Gravity muſt be thereby increaſed, because the ſame Quantity of Air, and conſequently of Weight, extenſively taken, is now contracted into a leſſer

Room, which therefore muſt be intenſively heavier (as being the ſame Weight in a leſſer Bulk.) Now this may poſſibly, as a great Preſſure, or ſtronger Spring, force up the Vapours under it with a greater *Impetus* (according to the Notion I mentioned before) and ſo make them fly higher: unleſs we ſhould ſuppoſe it may be relieved, by ſhortning the Height of the *Atmoſphere*:) but not ſo as to make them lighter; but rather the contrary, as preſſing them cloſer: Much leſs to make them (as the Phraſe is) *Specifically Lighter* than is the Air it ſelf (though thus compreſſed) and it leaves leſs Room to receive them between the Particles of the compreſſed Air, as being now thruſt cloſer together.

If the Spring be ſtrengthned the other way; ſo as by Heat it uſeth to be: This doth rather diminiſh its intenſive Gravity, by thruſting its Parts further aſunder, and ſo poſſeſſing a larger Room. Now in caſe this Air be, by a cloſe Veſſel, confined ſo as not to expand upward; it will certainly preſs the harder on the ſtagnant Quick-ſilver under, and make that in the Tube riſe higher: But in caſe it be unconfined, as in the open Air, it may as well relieve it ſelf upward, by making the *Atmoſphere* in this Part ſo much the higher.

Nor is there any Neceſſity, as to the ſubjacent Parts, that the *Atmoſphere* ſhall be every where of the ſame Height: But the Laws of *Staticks*, as to the ſubjacent Parts, be equally preſerved without it; the greater Altitude compenſating for the Levity of the Parts; as when a Portion of the Sea is covered with a Fleet of Ships, the under Parts are equally preſſed, partly by Water, and partly by Ships, though the Tops of the Ships over ſome Parts be higher than the Surface of the Water over others. Only, in ſuch Caſe, the upper Part of the *Atmoſphere*, being fluid, may flow collaterally over the other Parts on either ſide, if lower. And ſo, at leiſure, (if thus remaining otherwiſe undiſturbed) reduce it ſelf to an equal Height in all Parts; like as the Sea would do, in a perfect Calm, though otherwiſe its Waves and Billows are far from being in all Places perfectly plain and even.

But, however, though the Spring, fortified by Heat, may thus relieve it ſelf upwards, (yet becauſe it preſſeth every way,) it muſt endeavour the like downward alſo, and thereby preſs harder what is under it; and becauſe it will require Time to work upward gradually before the Effect reach the Top of the *Atmoſphere*; and becauſe by ſuch Dilatation of its Parts, more Room is left in the Intervals to receive what is forced: 'Tis reaſonable to believe, that in ſuch Caſes, the preſſed Vapour (*cæteris paribus*) may riſe more copiouſly, than when the Spring of the Air (for want of Heat) is leſs ſtrong. The rather, becauſe the ſame Heat which thus fortifies the Spring of the Air, doth alſo rarify the Vapours and make them lighter; and may alſo fortify the ſubterraneal Heat (or whatever elſe it is,) that drives them up. Notwithſtanding all which, we have more Rains in Winter; which ſhould argue, that more Vapours do then ariſe to ſupply them.

But I ſuſpect, that in this whole Buſineſs (of ſtrengthning the Spring) there may be a Fallacy put upon us: And what we think to be done upon the open Air, is indeed done upon the Quick-ſilver; or rather upon the Air latent therein. My Meaning is this; We find that in very hot Weather, and alſo in Froſty Weather, the Quick-ſilver in the Tube commonly ſtands very high; from whence we are apt to conclude, that therefore the outward Air preſſes very hard on the ſtagnant Quick-ſilver, without the Tube: Wherein I am not ſatisfy'd; for we are to conſider, that, in filling the Tube with Quick-ſilver, before it be inverted, if great Care be not uſed to cleanſe it from Air, many Airy Particles will remain mixed with it; which, while their Spring is weak, are eaſily preſſed by the Weight of the Quick-ſilver ſo cloſe, as hardly to be diſcerned otherwiſe than by the Effect: But when, by the external Heat, their Spring is ſtrengthned, they expand themſelves, and cauſe the Quick-ſilver, wherein they are, to ſwell in Bulk, without increaſing its Weight; and conſequently to ſtand higher, though not to preſs heavier.

And the ſame Account, perhaps, may ſerve for its ſtanding ſo high in froſty Weather. Water, we know, though it contract with Cold, yet when it comes to freeze, doth expand it ſelf; (which makes Ice lighter than Water, and to ſwim on the Top of it.) Now whether this be purely of it ſelf, or (in part at leaſt) from the Particles of Air lodged in it, may not perhaps be ſo eaſy to determine. However, if there be the like Effects on Air, as on Water, (namely, that it expands with Freezing,) or if in the Quick-ſilver there be lodged Particles of Water as well as of Air; we have, either way, an Account of this *Phænomenon*. For then the ſmall Particles, whether of Air, or of Water, lodged in the Quick-ſilver, being thus expanded by Freezing, will make the Quick-ſilver ſwell, and ſo ſtand higher, without increaſing its Weight; and conſequently, without arguing a greater Weight of external Air preſſing on the ſtagnant Quick-ſilver.

The Circulation of Watry Vapours, by Mr. Edm. Halley, n. 192. p. 468.

XXXIV. I have formerly attempted to explain the Manner of the riſing of Vapours by Warmth, by ſhewing, that if an Atom of Water were expanded into a Shell or Bubble, ſo as to be ten times as big in Diameter as when it was Water, ſuch an Atom would become *Specifically Lighter* than Air, and riſe ſo long as that *Flatus*, or warm Spirit, that firſt ſeparated it from the Maſs of Water, ſhall continue to diſtend it to the ſame Degree; and that Warmth declining, and the Air growing cooler, and with all *Specifically Lighter*, the Vapours conſequently ſhall ſtop at a certain Region of the Air, or elſe deſcend; which may happen upon ſeveral Accounts, as I ſhall by and by endeavour to make out. Yet I undertake not, that this is the only Principle of the Riſe of Vapours, and that there may not be a certain ſort of Matter whoſe *Conatus* may be contrary to that of Gravity; as is evident in Vegetation; wherein the Tendency of the Sprouts is directly upwards, or againſt the Perpendicular. But whatever is the true Cauſe, it is in Fact certain, that Warmth doth ſeparate the Particles of Water, and emit them with a greater and greater Velocity, as the Heat is more and more intenſe; as is evident in the Steam of a boiling Cauldron, wherein likewiſe the Velocity of the Aſcent of the Vapours does viſibly decreaſe till they diſappear, being diſperſed into and aſſimilated with the ambient Air.

Vapours being thus raiſed by Warmth, let us, for a firſt Suppoſition, put, that the whole Surface of this Globe were all Water, very deep, or rather that the whole Body of the Earth were Water, and that the Sun had his Diurnal Courſe about it: I take it, that it would follow that the Air of it ſelf would imbibe a certain Quantity of Aqueous Vapours, and retain them, like Salts diſſolved in Water; that the Sun warming the Air, and raiſing a more plentiful Vapour from the Water in the Day-time, the Air would ſuſtain a greater Proportion of Vapour, as warm Water will hold more diſſolved Salts, which upon the Abſence of the Sun in the Nights, would be all again diſcharged in Dews, analogous to the Precipitation of Salts on the cooling of the Liquors; nor is it to be believed, that in ſuch Caſe there would be any Diverſity of Weather, other than periodically, every Year alike, the Mixture of all Terreſtrious, Saline, Heterogeneous Vapours being taken away; which, as they are variouſly compounded, and brought by the Winds, ſeem to be the Cauſes of thoſe various Seaſons which we now find. In this Caſe the Airy Regions, every where at the ſame Height, would be equally repleniſhed with the Proportion of Water it could contain, regard being only to be had to the different Degree of Warmth, from the Nearneſs or Diſtance of the Sun; and an Eternal Eaſt-wind would blow all round the Globe, inclining only to the ſame ſide of the Eaſt, as the Latitude does from the *Æquator*; as is obſerved in the *Ocean* between the *Tropicks*.

Next let us ſuppoſe this Ocean interſperſed with wide and ſpacious Tracts of Land, with high Ridges of Mountains; ſuch as the *Pyrenean*, the *Alps*, the *Apennine*, the *Carpathean* in *Europe*; *Taurus*, *Caucaſus*, *Imaus*, and ſeveral others in *Aſia*; *Atlas*, and the *Montes Lunæ*, with other unknown Ridges in *Africa*, whence come the *Nile*, the *Nigre*, and the *Zaire*, and in *America* the *Andes*, and the *Apalatean* Mountains: Each of which far ſurpaſs the uſual Height to which the Aqueous *Vapours* of themſelves aſcend, and on the Tops of which the Air is ſo cold, and rarified, as to retain but a ſmall Part of thoſe Vapours that ſhall be brought thither by the Winds. Thoſe Vapours therefore that are raiſed copiouſly in the Sea, and by the Winds are carried over the low Land to thoſe Ridges of the Mountains, are there compelled by the Stream of the Air to mount up with it to the Tops of the Mountains, where the Water preſently *precipitates*, gleeting down by the Crannies of the Stone; and part of the Vapours entring into the Caverns of the Hills, the Water thereof gathers, as in an *Alembick*, into the Baſons of Stone it finds, which being once filled, all the Overplus of Water that comes thither, runs over by the loweſt Place, and breaking out by the Sides of the Hills, forms ſingle Springs; many of theſe running down by the Valleys, or Guts between the Ridges of the Hills, and coming to unite, form little *Rivulets* or *Brooks*; many of theſe again meeting in one common Valley, and gaining the plain Ground, being grown leſs rapid, become a *River*; and many of theſe being united into one common Channel, make ſuch *Streams* as the *Rhine*, the *Rhone*, the *Danube*; which latter, one would hardly think the Collection of Water condenſed out of *Vapour*, unleſs we conſider how vaſt a Tract of Ground that

River drains, and that it is the Sum of all thoſe *Springs* which break out on the South-ſide of the *Carpathian* Mountains, and on the North-ſide of the immenſe Ridge of the *Alps*, which is one continued Chain of Mountains from *Switzerland* to the *Black-Sea*. And it may almoſt paſs for a Rule, that the *Magnitude* of a *River*, or the Quantity of Water it evacuates, is proportionable to the Length and Height of the Ridges from whence its *Fountains* ariſe. Now this *Theory* of Springs is not a bare *Hypotheſis*, but founded on Experience, which it was my Luck to gain in my Abode at St. *Helena*; where in the Night-time, on the Tops of the Hills, about 800 Yards above the Sea, there was ſo ſtrange a Condenſation, or rather Precipitation of the Vapours, that it was a great Impediment to my Celeſtial Obſervation; for in the clear Sky the Dew would fall ſo faſt as to cover, each half quarter of an Hour, my Glaſſes with little Drops, ſo that I was neceſſitated to wipe them off ſo often, and my Paper, on which I wrote my Obſervations, would immediately be ſo wet with the Dew, that it would not bear Ink: By which it may be ſuppoſed how faſt the Water gathers in thoſe mighty high Ridges I but now named.

Thus is one Part of the Vapours blown upon the Land returned by the Rivers into the Sea, from whence they came. Another Part by the Cool of the Night falls in Dews, or elſe in Rains, again into the Sea before it reaches the Land; which is by much the greateſt Part of the whole Vapour, becauſe of the great Extent of the Ocean, which the Motion of the Winds does not traverſe in a very long Space of Time: And this is the Reaſon why the Rivers do not return ſo much into the *Mediterranean* as is extracted in Vapour. A third Part falls on the lower Lands, and is the *Pabulum* of *Plants*, where yet it does not reſt, but is again exhaled in Vapour by the Action of the Sun, and is either carried by the Winds to the Sea, to fall in Rain or Dew there; or elſe to the Mountains to be there turned into Springs: And though this does not immediately come to paſs, yet after ſeveral Viciſſitudes of riſing in Vapour, and falling in Rain or Dews, each Particle of the Water is at length returned to the Sea, from whence it came. Add to this, that the Rain-water, after the Earth is fully ſated with Moiſture, does by the Valleys or lower Parts of the Earth, find its Way into the Rivers, and ſo is compendiouſly ſent back to the Sea. After this Manner is the *Circulation* performed: and I doubt not but this *Hypotheſis* is more reaſonable, than that of thoſe who derive all Springs from the Rain-waters, which yet are perpetual, and without Diminution, even when no Rain falls for a long Space of Time: Or than that that derives them from a Filtration, or *Percolation* of the Sea-waters through certain imaginary Tubes or Paſſages within the Earth, wherein they loſe their Saltneſs; this, beſides many others, labouring under this principal Abſurdity, that the greateſt Rivers have their moſt copious Fountains fartheſt from the Sea, and whether ſo great Quantities of freſh Water cannot reaſonably be derived any other Way than in Vapour. This, if we may allow *Final Cauſes*, ſeems to be the Deſign of the Hills, that their Ridges being placed through the Midſt of the *Continents*, might ſerve, as it were, for *Alembicks*, to diſtil Freſh Water for the Uſe of Man and Beaſt, and their

Heights to give a Deſcent of thoſe Streams to run gently, like ſo many Veins of the *Macrocoſm*, to be the more beneficial to the Creation. If the Difference between Rain and Dew, and the Cauſe why ſometimes 'tis cloudy, at other times ſerene, be enquired; I can offer nothing like a proper Solution thereof, only with Submiſſion to propoſe Conjectures, which are the beſt I can find, *viz.* That the Air being heap'd up with the meeting of two contrary Winds, when the Mercury is high, the Vapours are the better ſuſtained and kept from coagulating or condenſing into Drops; whereby Clouds are not ſo eaſily generated: And in the Night the Vapours fall down ſingle as they aroſe in *imperceptible* Atoms of Water. Whereas when the Mercury is low, and the Air rarified by the Exhauſtion thereof, by two contrary Winds blowing from the Place, the Atoms of Air keep the Vapours not ſo well ſeparated, and they coaleſce into viſible Drops in the Clouds; and from thence are eaſily drawn into greater Drops of Rain. To which 'tis poſſible, and not improbable, that ſome ſort of ſaline or angular Particles of terreſtrial Vapour being immixt with the Aqueous, which I take to be Bubbles, may cut or break their Skins or Coats, and ſo contribute to their more ſpeedy Condenſation into *Rain*.

The Cauſe of Trade-Winds; *by Dr.* M. Liſter, n. 156. p. 494.

XXXV. The *Trade* or *Tropick Winds* ſeem in great Part to ariſe from the daily and conſtant Breath of the *Sargoſſa*, or *Lenticula Marina*, which grows in vaſt Quantities from 36 to 18 Degrees Northern Latitude, and elſewhere upon the deepeſt Seas; becauſe the Matter of that Wind, coming (as we ſuppoſe) from the Breath of only one Plant, it muſt needs make it conſtant and uniform; whereas the great Variety of Plants and Trees at Land, muſt needs furniſh a confuſed Matter of Winds. Again, the *Levant Breezes* are briſkeſt about Noon, the Sun quickning the Plant moſt then, cauſing it to breathe faſter and more vigorouſly; and that Plants moſtly languiſh in the Night, is evident from many of them, which contract themſelves, and cloſe at that time; alſo from the Effects of our Winters upon them, which cauſe them to caſt both Fruit and Leaves too; whereas they are ſaid (the ſame Plants for kind) univerſally to flouriſh all the Year alike within the *Tropicks*.

As for the Direction of this *Breeze* from Eaſt to Weſt, it may be owing to the general *Current* of the Sea; for a gentle Air will ſtill be led with the Stream of our Rivers, for Example. Again, every Plant is in ſome meaſure an *Heliotrope*, and bends itſelf, and moves after the Sun, and conſequently emits its Vapours thitherward; and ſo its Direction is in that Reſpect alſo owing in ſome meaſure to the Courſe of the Sun.

The Cauſe of Winds; *and of the Change of* Weather; *by Dr.* Geo. Gordon, n. 17. p. 1148.

XXXVI. 1. It is generally known that there are continual Eaſtern Winds under the *Line*, which they call *Breezes*; and therefore the Accounts of *Spaniſh* Voyages bear, that in their going to the *Weſt-Indies*, they ſail ſouthwards from *Spain*, along the Coaſt of *Africk*, till they be beyond the *Tropick* of *Cancer*, within 20 *Deg.* of the *Line*, where they preſently find an Eaſterly Wind, and ſo they ſail on Weſtwards with full Wind, ſo as they have ſcarce any Need to touch their Sails in the whole Voyage: And this they give as the Reaſon why the Voyage from *Spain* to the *Weſt-Indies* is ſhorter, more eaſy, and more aſſured, than the Return to *Spain*. In the

South Sea alſo going from *New Spain* or *Peru* to the *Philippines* or *China*, their Voyage is eaſy, ſailing always from Eaſt to Weſt near the *Line*, where the Eaſterly Winds blow in their Poop. *Acoſta* reports, that in the Year 1584, there went a Ship from *Calloa* in *Lima* to the *Philippines*, which ſailed 2700 Leagues without ſight of Land, and this in two Months, their Courſe being almoſt under the *Line*.

Now theſe continual Eaſterly Winds between the *Tropicks*, I ſuppoſe to proceed both from the Motion of the Earth, and the vertical Influences of the Sun; after this manner. As you know the vaſt Fluid and Æther, in which the Earth floats in its annual Motion, moves forward with the Earth in that Motion, or rather carries the Globe of the Earth along with it; even ſo the *Atmoſphere*, and a large Vortex of Æther beyond the Moon, goes round with the Earth in its Diurnal Motion; which tho', according as it is removed from the Earth, it may be proportionably ſlower in its Motion, yet that Portion of the *Atmoſphere*, which is neareſt the Earth, and ſurrounds it, may be ſuppoſed to keep equal Pace with the Earth in its Motion; and if there were no Changes in the *Atmoſphere*'s Gravity, I ſuppoſe it would always go along with the Globe of the Earth from Weſt to Eaſt in an uniform Motion, which would be wholly inſenſible to us. But that Portion of the *Atmoſphere* under the *Line*, being extreamly rarified, its Spring expanded, and ſo its Gravity and Preſſure much leſs than the neighbouring Parts of the *Atmoſphere*, and conſequently uncapable of the uniform Motion to the Eaſt, it muſt needs be preſt Weſt-wards, and make that continual *Breeze* from Eaſt to Weſt between the *Tropicks*.

2. The ſame Accounts bear, that on this Side the *Tropick*, about 28 or 30 *deg*. there are to be found conſtant Weſterly Winds; and therefore the *Spaniſh* Fleets from the *Weſt-Indies* do not return the Way they went, but thoſe both from *Peru*, and *New Spain*, ſail along the Coaſt Northward till they touch at *Havanna* in *Cuba*, and being join'd together there, they ſeek their Height without the *Tropicks*, where preſently they find Weſterly Winds, which ſerve them till they come in view of the *Azores*, and from thence to *Seville*. In like manner in the *South-Sea*, thoſe which return from the *Philippines*, or *China*, to *Mexico*, to the End they may recover the Weſtern Winds, mount a great Height till they come right againſt the Iſland of *Japan*; and diſcovering *California*, they return by the Coaſt of *New Spain* to the Port of *Acapulco*, from whence they parted. So that though they ſail eaſily from Eaſt to Weſt, in both Seas, within the *Tropicks*, for that the Eaſtern Winds reign there; yet returning from Weſt to Eaſt they muſt ſeek the Weſtern Winds without the *Tropicks* in the Height of 27 *Degrees*.

Now the Reaſon of this ſeems to me clearly deducible from the former; for the Preſſure of Air between the *Tropicks* being continually leſs than the neighbouring Parts of the *Atmoſphere*, and ſo conſequently by them preſſed Weſt-ward, way being thereby given to the neighbouring Air for ſome *Deg*. without the *Tropicks*; its Motion from Weſt to Eaſt is proportionably increas'd beyond that uniform Motion it would have, if the whole

Atmoſphere were of an equal Preſſure; and conſequently there will blow a conſtant Wind from Weſt to Eaſt for ſome *Degrees* beyond the *Tropicks*.

3. Thoſe Eaſterly Winds between the *Tropicks*, by what I can collect from the Accounts of Eaſtern Voyages, do not blow conſtantly from the ſame Point, nor directly from the Eaſt; but for the one half of the Year, *viz.* from *April* to *November*, or thereabouts, they come from the South-Eaſt; and for the other half of the Year, *viz.* from *November* to *April*, they blow from the North-Eaſt. And theſe I ſuppoſe they call their *Monſoons*, and *Trade-Winds*. Hence it is, that they who ſail from *China*, *Japan*, &c. to *Bantam*, muſt wait the Northerly *Monſoon*, which falls between *November* and *April*; and they who return from *Bantam*, muſt go back again when the Southerly *Monſoon* comes, which is between *April* and *November*; and the *Currents* of the Sea are ſaid to obſerve the ſame Motion and Changes with the Winds. I know not whether theſe *Monſoons* do blow exactly from the ſame Points in all Parts; for it's like, where there are Bays, Highlands, and Iſlands, &c. the *Monſoons* may blow from different Points: but this is chiefly to be underſtood of open Seas.

Now theſe *Monſoons*, I think, may be eaſily accounted for from what has already been ſaid, anent the Cauſe of the continual Eaſterly Winds between the *Tropicks*; for ſeeing the leſſening of the Air's Preſſure under the *Line*, and the Preſſure of the Neighbouring Parts of the *Atmoſphere* thereupon, occaſion theſe continual *Breezes*, if the Sun were conſtantly in the *Equinoctial Line*, it is like the Wind would blow ſtill directly from the Eaſt; but in that he is the one half of the Year on the one Side of the *Line*, and the other half on the other, there muſt of Neceſſity follow a Change of theſe *Breezes* into ſtated *Monſoons*. For, imagine the *Atmoſphere* to be divided into two equal Hemiſpheres by the *Equinoctial* Plane; if the Sun were always in the Plane, there would be ſtill an equal Preſſure from both theſe Hemiſpheres upon the Air under the *Line*, and the *Breeze* ſhould be directly from the Eaſt. But now when the Sun comes on the North-ſide of the *Line*, as far as the *Tropick* of *Cancer*, and back again, there is not an equal Balance, but the Preſſure of the Southern Hemiſphere of the Air muſt needs be greateſt, and conſequently the *Breeze* muſt blow all that Seaſon from the South-Eaſt; and when the Sun returns again to the Southward of the *Line*, as far as *Capricorn*, and back again, the Preſſure of the Northern Hemiſphere muſt needs preponderate, and make the Wind blow all that half Year from the North-Eaſt. And this ſeems to accord very well with Experience: for their Northern *Monſoons* are in our Winter Seaſon, when the Sun is in the Southern *Signs*; and their Southern ones in our Summer, when he is in the Northern *Signs*.

4. The Rivers of *Indus* and *Ganges*, where they enter the Ocean, do contain between them a large *Cherſoneſus*, which is divided in the Middle by a Ridge of high Hills, which they call the *Gate*, which run along from Eaſt to Weſt, and quite thorough to Cape *Comori*. On the one Side is *Malabar*, and on the other *Coromandel*. On the *Malabar* ſide, between that Ridge of Mountains and the Sea, it is, after their Appellation, Summer from *September* till *April*; in which time it is always a clear Sky, without once,

or very little, Raining. On the other Side the Hills, on the Coaſt of *Coromandel*, it is at the ſame time their Winter, every Day and Night yielding abundance of Rain. And from *April* to *September* it is, on the *Malabar* Side, their Winter, and on the other Side their Summer: So that in little more than 20 Leagues Journey in ſome Places, as where they croſs the Hills to St. *Thomas*; on the one Side of the Hill you aſcend with a fair Summer, on the other you deſcend with a ſtormy Winter. The like is ſaid to be at Cape *Razalgate* in *Arabia*. And Dr. *Trapham* relates the ſame of *Jamaica*, intimating that there is a Ridge of Hills which runs from Eaſt to Weſt thro' the Midſt of the Iſland, and that the Plantations on the South-ſide of theſe Hills have, from *November* to *April*, a continual Summer, whilſt thoſe on the North-ſide have as conſtant a Winter; and *è contra* from *April* to *November*.

From theſe and ſuch like Accounts it ſeems evident, that a bare leſſening of the *Atmoſphere*'s Gravity will not occaſion Rain, but that there is alſo needful either a ſudden Change of Winds, or a Ridge of Hills to meet the Current of the Air and Vapours, whereby the Particles of the Vapours are driven together, and ſo fall down into Drops of Rain. And hence it is, that whilſt the Wind blows from the North-eaſt, *viz.* from *November* to *April*, there are continual Rains in the northerly Plantations of *Jamaica*, and on the Side of *Coromandel* in the *Eaſt-Indies*, becauſe the Winds beat againſt that Side of the Hills; and ſo there is fair Weather on the other Side of theſe Hills, in *Malabar* and the ſouthern Plantations of *Jamaica*, there being no Winds to drive the Vapours together. But in the ſoutherly *Monſoon*, *viz.* from *April* to *November*, *Malabar* and the ſoutherly Plantations of *Jamaica*, have Floods of Rains, the Wind beating againſt that Side of the Hills; whilſt in *Coromandel* and the other Side of *Jamaica*, there is Fair and Clear Weather. The Maps make thoſe Mountains of *Gate* run South and North; and, if ſo, the *Monſoons* muſt blow from other Points, by reaſon of the neighbouring Countries and Iſlands; or elſe this is not the true Cauſe of theſe *Seaſons*.

5. This ſerves alſo to clear the *Singularity* of *Seaſons* in *Peru*, beyond any other Parts of the Earth, and ſeems to be aſſigned by *Acoſta*, as the Cauſe of it. *Peru* runs along from the *Line* Southwards about 1000 Leagues. It is ſaid to be divided into three Parts, long and narrow, which they call *Lanos*, *Sierras* and *Andes*; the *Lanos*, or Plains, run along the *South-Sea* Coaſt; the *Sierras* are all Hills, with ſome Vallies; and the *Andes* ſteep and craggy Mountains. The *Lanos* have ſome ten Leagues in Breadth, in ſome Parts leſs, and in ſome more; the *Sierras* contain ſome 20 Leagues in Breadth, the *Andes* as much, ſometimes more, ſometimes leſs; they run in Length from North to South, and in Breadth from Eaſt to Weſt. This Part of the World is ſaid to have theſe remarkable Things. 1. All along the Coaſt, in the *Lanos*, it blows continually with one only Wind, which is South and South-weſt, contrary to that which uſually blows under the *Torrid Zone*. 2. It never Rains, Thunders, Snows, or Hails, in all this Coaſt, or *Lanos*, though there falls ſometimes a ſmall Dew. 3. Upon the *Andes* it rains almoſt continually, though it be ſometimes more

clear than other. In the *Sierras*, which lie betwixt both the Extreams, it rains from *September* to *April*, but in the other Seaſons it is more clear, which is when the Sun is fartheſt off, and the contrary when it is neareſt. Now the Reaſon of all ſeems to be this. The Eaſtern *Breezes* which blow conſtantly under the *Line*, being ſtopt in their Courſe by the *Sierras* and *Andes*, and yet the ſame *Breezes* being to be found in the *South-Sea* beyond *Peru*, as appears by the eaſy Voyages from *Peru* to the *Philippines*, a Current of Wind blows from the South on the Plains of *Peru*, to ſupply the *Eaſtern Breeze* in the *South Seas*; and there being but one conſtant Gale in theſe Plains, and no contrary Winds, nor Hills for it to beat upon, this ſeems to be the Reaſon why the Vapours are never, or very ſeldom, driven into Rain. And the *Andes* being as high perhaps in many Places as the Vapours aſcend in the higheſt Degree of the *Atmoſphere*'s Gravity, this may probably be the Reaſon why the Eaſtern *Breeze*, beating conſtantly againſt theſe Hills, occaſions Rains upon them at all Seaſons of the Year. And the *Sierras* being, it ſeems lower than the *Andes*; therefore from *September* to *April*, when the Sun is neareſt, and ſo the *Atmoſphere*'s Gravity leſs, and the Vapours lower, they are driven againſt *Sierras* into Rain.

6. The Cauſes of thoſe particular, various, uncertain, and unconſtant Winds, which do blow in the Countries without the *Tropicks*, and that moſt frequently in mountainous Places, and more ſeldom in great Plains, ſuch as *Poland*, I cannot ſo eaſily conjecture: but thoſe general Winds which uſually fall out every where about both *Equinoctials*, ſeem to proceed from ſome general Cauſe: and this I take to be the Change of the *Monſoons*, and *Trade-Winds*, about theſe Times, between the *Tropicks*. For there muſt needs be about theſe Seaſons a Change of the Balance of the *Atmoſphere*, according to what I have diſcourſed on the third Head; and this, I think, cannot but occaſion ſtrong Winds over all the Earth.

2. Dr. *Gordon* endeavours to explain and give an Account of the *Trade-winds* within the *Tropicks*, from the different Gravity of the *Atmoſphere* at divers times of the Year. And yet it is aſſerted by Dr. *Liſter*, that the *Mercury* is not affected with the Weather, or very rarely, let it be cloudy, rainy, windy or ſerene, in St. *Helena* or the *Barbadoes*, and therefore probably not within the *Tropicks*, unleſs in a violent Storm or Hurricane. Now if the *Mercury* move little or nothing in the *Baroſcope*, 'tis likely there is little or no Change in the Gravity of the *Atmoſphere*, within the *Tropicks*. *By Mr.* W. Molyneux, n. 177. p. 1237. *Vid. Sect.* X. 11

3. The univerſal *Ocean* may moſt properly be divided into three Parts; *viz.* 1. The *Atlantick* and *Æthiopick* Sea. 2. The *Indian Ocean*. 3. The great *South-Sea*, or the *Pacifick Ocean*. *By Mr.* Halley, n. 183. p. 153.

1. In the *Atlantick* and *Æthiopick* Seas, between the *Tropicks*, there is a general Eaſterly Wind all the Year long, without any conſiderable Variation; excepting that it is ſubject to be deflected therefrom, ſome few Points of the Compaſs, towards the North or South, according to the Poſition of the Place.

1. Near the Coaſt of *Africa*, as ſoon as you have paſſed the *Canary Iſles*, you are ſure to meet a freſh Gale of *N. E.* Wind, about the Latitude of 28°, North, which ſeldom comes to the Eaſtwards of the *E. N. E.* or paſſes the *N. N. E.* This Wind accompanies thoſe bound to the Southward, to the La-

titude of 10° North, and about 100 Leagues from the *Guinea* Coaſt, where till the 4° of North Latitude, they fall into *Calms* and *Tornadoes*.

2. Thoſe bound to the *Caribbee Iſles*, find, as they approach the *American* Side, that the aforeſaid N. E. Wind becomes ſtill more and more Eaſterly, ſo as ſometimes to be E. ſometimes E. by S. but yet moſt commonly to the Northward of the Eaſt, a Point or two, ſeldom more. 'Tis likewiſe obſerved, that the Strength of theſe Winds does gradually decreaſe, as you ſail to the Weſtward.

3. That the *Limits* of the *Trade* and *Variable* Winds in this *Ocean*, are farther extended on the *American* Side than the *African*; for whereas you meet not with this certain Wind till after you have paſt the Latitude of 28° on this Side; on the *American* Side it commonly holds to 30, 31, or 32° of Latitude; and this is verified likewiſe to the Southward of the *Equinoctial*, for near the *Cape of Good Hope*, the Limits of the *Trade Winds* are 3 or 4° nearer the Line than on the Coaſt of *Braſil*.

4. That from the Latitude of 4° North to the aforeſaid Limits on the South-ſide of the *Æquator*, the Winds are generally and perpetually between the South and Eaſt, and moſt commonly between the South-Eaſt and Eaſt; obſerving always this Rule, that on the *African* Side they are more ſoutherly, on the *Braſilian* more eaſterly, ſo as to become almoſt due Eaſt, the little Deflexion they have being ſtill to the Southwards. In this Part of the *Ocean* it has been my Fortune to paſs a full Year, in an Employment that obliged me to regard more that ordinarily the Weather, and I found the Winds conſtantly about the South-eaſt, the moſt uſual Point *S. E. by E.* when it was Eaſterly it generally blew hard, and was gloomy, dark, and ſometimes rainy Weather; if it came to the Southwards, it was generally ſerene, and a ſmall Gale next to a Calm; but this is not very common. But I never ſaw it to the Weſtwards of the South, or Northwards of the Eaſt.

5. That the Seaſon of the Year has ſome ſmall Effect on theſe *Trade-winds*, for that when the Sun is conſiderably to the Northwards of the *Æquator*, the South-eaſt Winds, eſpecially the Streight of this Ocean, (if I may ſo call it) between *Braſil* and the Coaſt of *Guinea*, do vary a Point or two to the Southwards, and the North-eaſt become more Eaſterly; and, on the contrary, when the Sun is towards the *Tropick* of *Capricorn*, the South-eaſterly Winds become more Eaſterly, and the North-eaſterly Winds on this Side the Line were more to the Northward.

6. There is in this *Ocean* a Tract of Sea, wherein the Southerly and South-weſt Winds are perpetual, *viz.* all along the Coaſt of *Guinea*, for above 500 Leagues together, from *Sierra Leona* to the Iſle of St. *Thomas*; for the South-eaſt *Trade-Wind* having paſſed the *Line*, and approaching the Coaſt of *Guinea*, within 80 or 100 Leagues, inclines towards the Shore, and becomes *S. S. E.* and by Degrees, as you come nearer, it veers about to South, *S. S. W.* and Fig. 10. in with the Land *South-Weſt*, and ſometimes *W. S. W.* which Variation is better expreſſed in the Map than it can well be in Words. Theſe are the Winds which are obſerved on this Coaſt when it blows true, but there are frequent Calms, violent ſudden Guſts, called *Tornadoes*, from all Points of the

Compaſs, and ſometimes unwholeſome, foggy, eaſterly Winds, called *Hermitae*, by the Natives, which too often infeſt the Navigation of theſe Parts.

7. That to the Northwards of the Line, between 4 and 10 *deg.* of *Latitude*, and between the Meridians of *Cape Verde*, and of the Eaſtermoſt Iſlands that bear that Name, there is a Tract of Sea, wherein it were improper to ſay there is any *Trade Wind*, or yet a *Variable*, for it ſeems condemned to perpetual Calms, attended with terrible Thunder and Lightning, and Rains ſo frequent, that our Navigators from thence call this part of the Sea the *Rains:* the little Winds that are, be only ſome ſudden uncertain Guſts, of very little Continuance and leſs Extent; ſo that ſometimes each Hour you ſhall have a different Gale, which dies away into a Calm before another ſucceed; and in a Fleet of Ships in Sight of one another, each ſhall have the Wind from a ſeveral Point of the Compaſs; with theſe weak *Breezes*, Ships are obliged to make the beſt of their way to the Southward, thro' the aforeſaid ſix *Degrees*, wherein 'tis reported ſome have been detained whole Months for want of Wind.

From the three laſt Obſervables is ſhewn the Reaſon of two notable Occurrents in the *Eaſt-India* and *Guinea* Navigations. The one is, why notwithſtanding the narroweſt Part of the Sea, between *Guinea* and *Braſil*, be about 500 Leagues over; yet Ships bound to the Southward, ſometimes, eſpecially in the Months of *July* and *Auguſt*, find a great Difficulty to paſs it. This happens, becauſe of the South-eaſt Winds, at that time of the Year, commonly extending ſome *deg.* beyond the ordinary Limit of 4 *deg.* North *Lat.* and withal they come ſo much ſoutherly, as to be ſometimes South, ſometimes a Point or two to the Weſt; there remains then only to ply to Windward, and if, on the one ſide they ſtand away *W. S. W.* they gain the Wind ſtill more and more eaſterly, but there is Danger of not weathering the *Braſilian* Shore, or at leaſt the Shoals upon that Coaſt. But if upon the other Tack they go away *E. S. E.* they fall into the Neighbourhood of the Coaſt of *Guinea*, from which there is no departing without running Eaſterly, as far as the Iſle of St. *Thomas*, which is the conſtant Practice of all the *Guinea* Ships, and which may ſeem very ſtrange, without the Conſideration of the 6th Remark, which ſhews the Reaſon of it. For being in with the Coaſt, the Wind blows generally at *S. W.* and *W. S. W.* with which Winds they cannot go to the Northward for the Land, and on the other Tack, they can lie no nearer the Wind than *S. S. E.* or *S.* and with theſe Courſes they run off the Shore, but in ſo doing they always find the Winds more and more contrary; ſo that when near the Shore, they could lie South, at a greater Diſtance they can make their way no better than *S. E.* and afterwards *E. S. E.* with which Courſes they fetch commonly the Iſle of St. *Thomas* and Cape *Lopez*, where, finding the Winds to the Eaſtward of the South, they keep them favourable, by running away to the Weſtward in the South *Lat.* 3 or 4 *Deg.* where the *S. E.* Winds are perpetual.

For the ſake of theſe general Winds, all thoſe that uſe the *Weſt-Indian* Trade, even thoſe bound to *Virginia*, count it their beſt Courſe to get as ſoon as they can to the Southwards that ſo they may be certain of a fair and freſh Gale, to run before it to the Weſt-wards; and for the ſame Reaſon thoſe homewards bound from *America*, endeavour to gain the Latitude of 30 *deg.* as ſoon as poſſible, where they firſt find the Winds begin to be variable; tho' the moſt ordinary Winds in the northern Part of the *Atlantick Ocean* come from between the South and Weſt.

As to thoſe furious Storms called *Hurricanes*, which are, as it were, peculiar to the *Caribbee Iſles*; and which ſo dreadful afflict them in the Month of *Auguſt*, or not much before or after, they do not ſo properly belong to this Place, both by Reaſon of their ſmall Continuance and Extent, as likewiſe becauſe they are not Anniverſary; ſome Years having more than one, and ſometimes for ſeveral Years together there being none at all. But their Violence is ſo inconceivable, and their other *Phænomena* ſo ſurpriſing, that they merit well to be conſidered apart.

What is here ſaid, is to be underſtood of the Sea-Winds, at ſome Diſtance from the Land; for, upon and near the Shores, the Land and Sea Breezes are almoſt every where ſenſible; and the great Variety which happens in their Periods, Force and Direction, from the Situation of the Mountains, Vallies and Woods, and from the various Texture of the Soil, more or leſs capable of retaining and reflecting Heat, and of exhaling or condenſing Vapours, is ſuch, that it were an endleſs Task to endeavour to account for them.

2. In the *Indian* Ocean, the Winds are partly general, as in the *Ethiopick* Ocean, partly periodical, that is, half the Year they blow one way, and the other half near upon the oppoſite Points; and theſe Points and Times of Shifting are different in different Parts of this Ocean.

1. Between the Latitudes of 10 *deg.* and 30 *deg.* South between *Madagaſcar* and *Hollandia Nova*, the *General Trade-Winds* about the *S. E. by E.* is found to blow all the Year long, to all Intents and Purpoſes after the ſame Manner as in the ſame Latitudes in the *Æthiopick Ocean*, as it is deſcribed in the 4th Remark aforegoing.

2. That the aforeſaid *S. E.* Winds do extend to within 2 *deg.* of the *Æquator*, during the Months of *June*, *July*, *Auguſt*, &c. to *November*, at which time, between the South Latitudes of 3 and 10 *Deg.* being near the Meridian of the North End of *Madagaſcar*; and between 2 and 12 South Latitude, being near *Sumatra* and *Java*; the contrary Winds from the *N. W.* or between the North and Weſt, ſet in and blow for half a Year, *viz.* from the Beginning of *December* till *May*: and this *Monſoon* is obſerved as far as the *Molucca Iſles*; of which more anon.

3. That to the Northward of 3 *Deg.* South Latitude, over the whole *Arabian* or *Indian Sea* and *Gulf* of *Bengal*, from *Sumatra* to the Coaſt of *Africa*, there is another *Monſoon*, blowing from *October* to *April*, upon the *N. E.* Points; but in the other half Year, from *April* to *October*, upon the oppoſite Points of *S. W.* and *W. S. W.* and that with rather more Force than the other, accompanied with dark rainy Weather, whereas the *N. E.* blows clear. 'Tis likewiſe to be noted, that the Winds are not ſo conſtant, either in Strength or Point, in the *Gulf* of *Bengal*, as they are in the *Indian* Sea,

where a certain ſteady Gale ſcarce ever fails. 'Tis alſo remarkable, that the *S. W.* Winds in theſe Seas are generally more Southerly on the *African* Side, more Weſterly on the *Indian.*

4. There is a Tract of *Sea* to the Southwards of the *Æquator*, ſubject to the ſame Changes of the Winds, *viz.* near the *African* Coaſt, between it and the Iſland *Madagaſcar* or St. *Lawrence*, and from thence Northwards as far as the *Line*; wherein from *April* to *October* there is found a conſtant Freſh *S.S.W.* Wind, which, as you go more Northerly, becomes ſtill more and more Weſterly, ſo as to fall in with the *W.S.W.* Winds, mention'd before in thoſe Months of the Year to be certain to the Northward of the *Æquator:* What Winds blow in thoſe Seas for the other half Year, I have not yet been able to obtain to my full Satisfaction: The Account which has been given me is only this, that the Winds are much Eaſterly hereabouts, and as often to the North of the true Eaſt as to the Southwards thereof.

5. That to the Eaſtward of *Sumatra* and *Malacca*, to the Northwards of the *Line*, and along the Coaſt of *Camboia* and *China*, the *Monſoons* blow North and South; that is to ſay, the *N. E.* Winds are much Northerly, and the *S. W.* much Southerly. This Conſtitution reaches to the Eaſtwards of the *Philippine* Iſles, and as far Northerly as *Japan*. The Northern *Monſoon* ſetting in, in theſe Seas, in *October* or *November*, and the Southern in *May*, blowing all the Summer Months. Here it is to be noted, that the Points of the Compaſs, from whence the Winds come in theſe Parts of the World, are not ſo fixt as in thoſe lately deſcrib'd; for the Southerly will frequently paſs a Point or two to the Eaſtwards of the South, and the Northerly as much to the Weſtwards of the North; which ſeems occaſioned by the great Quantity of Land which is interſperſed in theſe Seas.

6. That in the ſame *Meridians*, but to the Southward of the *Æquator*, being that Tract lying between *Sumatra* and *Java* to the Weſt, and *New-Guinea* to the Eaſt, the ſame Northerly and Southerly *Monſoons* are obſerved; but with this Difference, that the Inclination of the Northerly is towards the *N. W.* and of the Southerly towards the *S. E.* but the *Plagæ Venti* are not more conſtant here than in the former, *viz. Variable* 5 or 6 Points: Beſides, the Times of the Change of theſe Winds are not the ſame as in the *Chineſe* Seas, but about a Month or 6 Weeks later.

7. That theſe contrary Winds do not ſhift all at once, but in ſome Places the Time of the Change is attended with *Calms*, in others with *Variable* Winds; and it is particularly remarkable, that the End of the Weſterly *Monſoon* on the Coaſt of *Coromandel*, and the two laſt Months of the Southerly *Monſoon* in the Seas of *China*, are very ſubject to be *Tempeſtuous:* The Violence of theſe Storms is ſuch, that they ſeem to be of the Nature of the *Weſt-India Hurricanes*, and render the Navigation of theſe Parts very unſafe about that time of the Year. Theſe *Tempeſts* are by our Seamen uſually termed, the *Breaking up of the Monſoons.*

By reaſon of the ſhifting of theſe Winds, all thoſe that ſail in theſe Seas, are oblig'd to obſerve the Seaſons proper for their Voyages, and ſo doing, they fail not of a fair Wind and ſpeedy Paſſage; but if ſo be they chance to out-ſtay their Time, till the contrary *Monſoon* ſets in, as it frequently happens, they are forced to give over the Hopes of accompliſhing their intended Voyages, and either return to the Port from whence they came, or elſe put into ſome other Harbour, there to ſpend the Time till the Winds ſhall come favourable.

8. That Navigation that there is on the *Mare Pacificum*, is by the *Spaniards*, who go yearly from the Coaſt of *New-Spain* to the *Manilha*'s: But that is but by one beaten Tract; ſo that I cannot be ſo particular here as in the other two. What the *Spaniſh* Authors ſay of the Winds they find in their Courſes, and what is confirm'd by the old Accounts of *Drake* and *Candiſh*, and ſince by *Schooten*, who ſailed the whole Breadth of this Sea in the Southern *Latitude* of 15 or 16 *deg.* is, that there is a great Conformity betwixt the Winds of this Sea, and thoſe of the *Atlantick* and *Ethiopick*; that is to ſay, that to the Northwards of the *Æquator*, the predominant Wind is between the *E.* and *N. E.* and to the Southwards thereof, there is a conſtant ſteady Gale between the *E.* and *S. E.* and that on both Sides the *Line*, with ſo much Conſtancy that they ſcarce ever need to attend the Sails, and ſo much Strength, that it is rare to fail of Croſſing this vaſt *Ocean* in ten Weeks time, which is about 130 Miles *per diem*: Beſides, 'tis ſaid that Storms and Tempeſts are never known in theſe Parts; wherefore ſome have thought it might be as ſhort a Voyage to *Japan* and *China*, to go by the *Streights* of *Magellan*, as by the *Cape of Good Hope*.

The Limits of theſe *General* Winds are alſo much the ſame as in the *Atlantick* Sea, *viz.* about the 30th Degree of *Latitude* on both Sides; for the *Spaniards*, Homewards bound from the *Manilha*'s, always take the Advantage of the Southerly *Monſoon*, blowing there in the Summer Months, and run up to the Northwards of that *Latitude*, as high as *Japan*, before they meet with *Variable* Winds, to ſhape their Courſe to the Eaſtwards. And *Schooten* and others that have gone about by the *Magellan Streights*, have found the Limits of *S. E.* Winds, much about the ſame *Latitude* to the Southwards; beſides, a farther Analogy between the Winds of this *Ocean* and the *Æthiopick* appears in that, that upon the Coaſt of *Peru* they are always much Southerly, like as they are found near the Shores of *Angola*.

Fig. 20. To help the Conception of the Reader in a matter of ſo much Difficulty, I believ'd it neceſſary to adjoin a *Scheme*, ſhewing, at one View, all the various *Tracts* and *Courſes* of theſe Winds. The *Limits* of theſe ſeveral *Tracts* are deſigned every where by prickt Lines, as well in the *Atlantick* and *Æthiopick*, where they are the Boundaries of the *Trade* and *Variable* Winds, as in the *Indian Ocean*, where they alſo ſhew the Extent of the ſeveral *Monſoons*. The Courſe of the Winds is expreſt by Rows of Stroaks in the ſame Line that a Ship would move, going always before it; the ſharp End of each little Stroak pointing out that Part of the *Horizon*, from whence the Wind continually comes; and where there are *Monſoons*, the Rows of the Stroaks run alternately backwards and forwards, by which means they are thicker there than elſewhere. As to the great *South-Sea*, conſidering its vaſt Extent, and the little Variety there is in its Winds, and the great Analogy between them, and thoſe of the *Atlantick* and *Æthiopick Oceans*; beſides, that, the greateſt Part thereof is wholly unknown to us; I thought it unneceſſary to lengthen the *Map* therewith.

In the foregoing Hiſtory are contained ſeveral Problems, that merit well the Conſideration of our acuteſt Naturaliſts, both by reaſon of the Conſtancy of the Effect, and of the immenſe Extent thereof; near half the Surface of the Globe being concerned; wherein if I am not able to account for all Particulars, yet 'tis hoped the Thoughts I have ſpent thereon, will not be judged wholly loſt by the Curious in natural Inquiries.

1. *Wind* is moſt properly deſigned to be the Stream or Current of the Air; and where ſuch Current is perpetual, and fixt in its Courſe, 'tis neceſſary that it proceed from a permanent unintermitting Cauſe, capable of producing a like conſtant Effect, and agreeable to the known Properties of the Elements of *Air* and *Water*, and the Laws of the Motion of fluid Bodies. Such an one is, I conceive, the Action of the Sun's Beams upon the *Air* and *Water*, as he paſſes every Day over the *Oceans*, conſidered together with the Nature of the Soil and Situation of the adjoining *Continents*. I ſay, therefore, *Firſt*, That, according to the Laws of *Staticks*, the Air, which is leſs rarified or expanded by Heat, and conſequently more ponderous, muſt have a Motion towards thoſe Parts thereof which are more rarified, and leſs ponderous, to bring it to an *Æquilibrium*; and, *Secondly*, That the Preſence of the Sun continually ſhifting to the Weſtwards; that Part towards which the Air tends, by reaſon of the Rarefaction made by his greateſt Meridian Heat, is with him carried Weſtward, and conſequently the Tendency of the whole Body of the lower Air is that way. Thus a *General* Eaſterly Wind is formed, which being impreſſed upon all the Air of a vaſt Ocean, the Parts impel one the other, and ſo keep moving till the next Return of the Sun; whereby ſo much of the Motion as was loſt, is again reſtor'd, and thus the Eaſterly Wind is made *Perpetual*.

2. From the ſame Principle it follows, that this Eaſterly Wind ſhould, on the North-ſide of the *Æquator*, be to the Northwards of the Eaſt, and in South *Latitudes* to the South thereof; for, near the *Line*, the Air is much more rarified, than at a greater Diſtance from it; becauſe of the Sun's being twice in a Year vertical, and at no time diſtant above 23 *deg.* and a half, at which Diſtance the Heat, being as the Sine of the Angle of Incidence, is but little ſhort of that of the perpendicular Ray. Whereas under the *Tropicks*, though the Sun ſtay long vertical, yet he is as long 47 *deg.* off; which is a kind of Winter, wherein the Air ſo cools, as that the Summer Heat cannot warm it to the ſame Degree with that under the *Æquator*: wherefore the Air to the Northwards and Southwards, being leſs rarified than that in the Middle, it follows, that from both Sides it ought to tend towards the *Æquator*. This Motion compounded with the former Eaſterly Wind, anſwers all the *Phænomena* of the General *Trade-Winds*; which, if the whole Surface of the Globe were Sea, would undoubtedly blow all round the World, as they are found to do in the *Atlantick* and *Æthiopick Oceans*.

3. But ſeeing that ſo great *Continents* do interpoſe and break the Continuity of the *Ocean*, regard muſt be had to the Nature of the Soil and the Poſition of the high Mountains; which I ſuppoſe the two principal Cauſes

of

of the ſeveral *Variations* of the *Winds* from the former General Rule: For if a Country lying near the Sun prove to be flat, ſandy, low Land, ſuch as the *Deſarts* of *Lybia* are uſually reported to be, the Heat occaſioned by the Reflection of the Sun's Beams, and the Retention thereof in the Sand, is incredible to thoſe who have not felt it; whereby the Air being exceedingly rarified, it is neceſſary that the cooler and more denſe Air ſhould run thitherwards to reſtore the *Æquilibrium.* This I take to be the Cauſe, why near the Coaſt of *Guinea* the Wind always ſets in upon the Land, blowing Weſterly inſtead of Eaſterly; there being ſufficient Reaſon to believe, that the Inland Parts of *Africa* are prodigiouſly hot, ſince the Northern Borders thereof were ſo intemperate, as to give the Antients Cauſe to conclude, that all beyond the *Tropick* was made *Uninhabitable* by Exceſs of Heat. From the ſame Cauſe it happens, that there are ſo conſtant *Calms* in that Part of the Ocean, called the *Rains* (deſcribed in the 7th Remark on the *Atlantick Sea:)* For this Tract being placed in the Middle, between the Weſterly Winds blowing on the Coaſt of *Guinea*, and the Eaſterly *Trade-Winds* blowing to the Weſtwards thereof, the Tendency of the Air here is indifferent to either, and ſo ſtands in *Æquilibrio* between both; and the Weight of the incumbent *Atmoſphere* being diminiſhed by the continual contrary Winds blowing from hence, is the Reaſon that the Air here holds not the copious Vapour it receives, but lets it fall into ſo frequent *Rains*.

4. But as the cool and denſe Air, by reaſon of its greater Gravity, preſſes upon the hot and rarified, 'tis demonſtrative that this latter muſt aſcend in a continual Stream as faſt as it rarifies, and that being aſcended, it muſt diſperſe it ſelf to preſerve the *Æquilibrium*, that is, by a *contrary Current*, the upper Air muſt move from thoſe Parts where the greateſt Heat is: So by a kind of Circulation, the *N. E. Trade-Wind* below will be attended with a *S. W.* above, and the *S. E.* with a *N. W.* Wind above. And that this is more than a bare Conjecture, the almoſt inſtantaneous Change of the Wind to the oppoſite Point, which is frequently found in paſſing the Limits of the *Trade-Winds*, ſeems to aſſure us: But that which above all confirms this *Hypotheſis*, is the *Phænomenon* of the *Monſoons*, by this Means moſt eaſily ſolved, and without it hardly explicable. Suppoſing therefore ſuch a Circulation as above; 'tis to be conſidered, that to the Northward of the *Indian Ocean* there is every where Land within the uſual Limits of the *Latitude* of 30, *viz. Arabia*, *Perſia*, *India*, &c. which, for the ſame Reaſon as the Mediterranean Parts of *Africa*, are ſubject to unſufferable Heats when the Sun is to the North, paſſing nearly Vertical, but yet are temperate enough when the Sun is removed towards the other *Tropick*, becauſe of a Ridge of Mountains at ſome Diſtance within the Land, ſaid to be frequently in Winter covered with Snow, over which, the Air, as it paſſes, muſt needs be much chilled. Hence it comes to paſs, that the Air coming, according to the general Rule, out of the *N. E.* in the *Indian* Seas, is ſometimes hotter, ſometimes colder, than that which by this Circulation is returned out of the *S. W.* and by Conſequence, ſometimes the under Current or Wind is from the *N. E.* ſometimes from no other

Cauſe, is clear from the Times wherein theſe Winds ſet in, *viz.* in *April*, when the Sun begins to warm thoſe Countries to the North, the *S. W. Monſoon* begins, and blows during the Heats till *October*, when the Sun being retired, and all Things growing cooler Northward, and the Heat increaſing to the South, the *N. E.* Winds enter and blow all the Winter till *April* again.

5. And it is undoubtedly from the ſame Principle that to the Southwards of the *Æquator*, in part of the *Indian Ocean*, the *N. W.* Wind ſucceeds the *S. E.* when the Sun draws near the *Tropick* of *Capricorn*. But I muſt confeſs, that in this latter occurs a Difficulty not well to be accounted for, which is, why this Change of the *Monſoons* ſhould be any more in this *Ocean*, than in the ſame *Latitudes* in the *Æthiopick*, where there is nothing more certain than a *S. E.* Wind all the Year.

6. 'Tis likewiſe very hard to conceive, why the Limits of the *Trade-winds* ſhould be fixt about the 30th *Deg.* of *Latitude* all round the Globe; and that they ſhould ſo ſeldom tranſgreſs or fall ſhort of thoſe Bounds: as alſo that in the *Indian* Sea, only the Northern Part ſhould be ſubject to the changeable *Monſoons*, and in the Southern there be a conſtant *S. E.*

Theſe are Particulars that merit to be conſidered more at large, and furniſh a ſufficient Subject for a juſt Volume.

Obſervations upon May-Dew; *by Mr.* Tho. Henſhaw, n. 3. p. 33.

XXXVII. Mr. *Henſhaw* has obſerv'd, That *Dew* newly gathered, and filtred through a clean Linen Cloth, tho' it be not very clear, is of a yellowiſh Colour, ſomewhat approaching to that of Urine.

That having endeavour'd to putrify it, by putting ſeveral Proportions into glaſs Bodies with blind Heads, and ſetting them in ſeveral Heats, as of Dung, and gentle Baths, he quite failed of his Intention: for Heat, tho' never ſo gentle, did rather clarify and preſerve it ſweet, though continued for two Months together, than cauſe any Putrefaction or Separation of Parts.

That expoſing of it to the Sun for a whole Summer in Glaſſes, that hold about 2 Gallons, with narrow Mouths that might be ſtopped with Cork, the only conſiderable Alteration he obſerved to be produced in it was, that Store of green Stuff (ſuch as is ſeen in Summer in Ditches and ſtanding Waters) floated on the Top, and in ſome Places grew to the Sides of the Glaſs.

That putting 4 or 5 Gallons of it into a half Tub, as they call it, of Wood, and ſtraining a Canvas over it to keep out Duſt and Inſects, and letting it ſtand in ſome ſhady Room for 3 Weeks or a Month, it did of it ſelf putrify and ſtink exceedingly, and let fall to the Bottom a black Sediment like Mud.

That coming often to ſee what Alterations appeared in the Putrefaction, he obſerved, that at the Beginning, within 24 Hours, a ſlimy Film floated on the Top of the Water; which after a while falling to the Bottom, there came another ſuch Film in its Place.

That if *Dew* were put into long narrow Veſſels of Glaſs, ſuch as formerly were uſed for *Receivers* in diſtilling of *Aqua Fortis*, the Slime would riſe to that Height, that he could take it off with a Spoon; and when he had put a pretty Quantity of it into a Drinking-glaſs, and it had ſtood all Night and the Water drained from it, if he had turned it out on his Hand, it would ſtand upright in Figure of the Glaſs, in Subſtance like boiled white Starch, tho' ſomewhat more tranſparent; if his Memory, *ſaith he*, fail him not.

That having once gotten a pretty Quantity of this Gelly, and put it into a Glaſs-body and Blind-head, he ſet it into a gentle Bath, with an Intention to have putrified it; but after a few Days, he found the Head had not been well luted on, and that ſome Moiſture exhaling, the Gelly was grown almoſt dry, and a large *Muſhroom* was grown out of it within the Glaſs; it was of a looſe wateriſh Contexture, ſuch an one as he had ſeen growing out of rotten Wood.

That having ſeveral Tubs with good Quantity of *Dew* in them, ſet to putrify in the Manner aboveſaid, and coming to pour out of one of them to make uſe of it, he found in the Water a great Bunch bigger than his Fiſt, of thoſe Inſects commonly called *Hog-lice*, or *Millepedes*, tangled together by their long Tails, one of which came out of every one of their Bodies about the Bigneſs of a Horſe Hair. The Inſects did all live and move after they were taken out.

That emptying another Tub, whereon the Sun, it ſeems, had uſed ſometimes to ſhine, and finding, upon the ſtraining it thro' a clean Linen Cloth, two or three Spoonfuls of green Stuff, though not ſo thick nor ſo green as that above mentioned, found in the Glaſſes purpoſely expoſed to the Sun; he put this green Stuff in a Glaſs, and tied a Paper over it, and coming ſome Days after to view it, he found the Glaſs almoſt filled with an innumerable Company of ſmall Flies, almoſt all Wings, ſuch as are uſually ſeen in great Swarms in the Air in Summer Evenings.

That ſetting about a Gallon of this *Dew* (which, he ſaith, if he miſremember not, had been firſt putrified and ſtained) in an open Jarr-Glaſs with a wide Mouth, and leaving it for many Weeks ſtanding in a South-window on which the Sun lay very much, but the Caſements were kept cloſe ſhut; after ſome time, coming to take Account of his *Dew*, he found it very full of little *Inſects*, with great Heads and ſmall tapering Bodies, ſomewhat reſembling *Tadpoles*, but very much leſs. Theſe, on his Approach to the Glaſs, would ſink down to the Bottom, as it were, to hide themſelves, and upon his Retreat, wriggle themſelves up to the Top of the Water again. Leaving it thus for ſome time longer, he afterwards found the Room very full of *Gnats*, tho' the Door and Windows were kept ſhut. He adds, that he did not at firſt ſuſpect that thoſe *Gnats*, had any Relation to the *Dew*; but, after finding the *Gnats* to be multiplied, and the little watry Animals to be much leſſened in Quantity, and finding great Numbers of their empty Skins floating on the Face of his *Dew*, he thought he had juſt Reaſon to perſuade himſelf that the *Gnats* were by a ſecond Birth produced of thoſe little Animals.

That vapouring away great Quantities of his putrified Dew in Glaſs Baſons and other earthen glazed Veſſels, he did at laſt obtain, as he remembers, above 2 Pound of greyiſh Earth; which, when he had waſhed with more of the ſame Dew out of all his Baſons into one, and vapoured to Siccity, lay in

Leaves one above another, not unlike to ſome Kind of brown Paper, but very friable.

That taking this Earth out, and after he had well ground it on a Marble, and given it a ſmart Fire in a coated Retort of Glaſs, it ſoon melted and became a Cake in the Bottom when it was cold, and looked as if it had been Salt and Brimſtone in a certain Proportion melted together; but, as he remembers, was not at all *inflammable*. This ground again on a Marble, he ſaith, did turn ſpring Water of a reddiſh, purple Colour.

That by often calcining and filtring this Earth, he did at laſt extract 2 *Ounces* of a fine ſmall white *Salt*, which looked on through a good *Microſcope*, ſeem'd to have Sides and Angles in the ſame Number and Figure, as *Rock Petre*.

XXXVIII. 1. We had of late in the County of *Limerick* and *Tipperary*, Showers of a Sort of Matter like Butter or Greaſe; if one rub it upon one's Hand it will melt, but lay it by the Fire and it dries and grows hard, having a very ſtinking Smell. Some of it fell here at *Kilkenny*, *Nov.* 14, 1695. which I did ſee myſelf the next Morning.

A kind of Dew *like Butter, in* Ireland; *by Mr.* R. Vans, n. 220. p. 333.

2. Having very diligently enquired concerning a very odd Phænomenon, which was obſerved in many Parts of *Munſter* and *Leinſter*, the beſt Account I can collect thereof, is as follows: For a good Part of the Winter 1695, and Spring following, there fell in ſeveral Places a Kind of thick Dew, which the Country People call'd *Butter*, from the Conſiſtency and Colour of it, being ſoft, clammy, and of a dark Yellow; it fell always in the Night, and chiefly in mooriſh low Grounds, on the Top of the Graſs; and often on the Thatch of Cabbins; 'twas ſeldom obſerv'd in the ſame Places twice, it commonly lay on the Earth for near a Fortnight without changing its Colour, but then dried and turned black; Cattle fed in the Fields where it lay indifferently as in other Fields: It fell in Lumps often as big as the End of one's Finger, very thin and ſcatteringly; it had a ſtrong ill Scent, ſomewhat like the Smell of Church-Yards or Graves; and indeed, we had during moſt of that Seaſon very ſtinking Fogs, ſome Sediment of which might poſſibly occaſion this ſtinking Dew, tho' I will by no means pretend to offer that as a Reaſon of it. I cannot find that it was kept long, or that it bred any *Worms* or *Inſects*; yet the ſuperſtitious Country People, who had ſcall'd or ſore Heads, rubb'd them with this Subſtance, and ſaid it healed them.

By the Biſhop of Cloyne, *ib.*

XXXIX. *Dec.* 6, 1631. Being in the Gulf of *Volo*, riding at Anchor, about 10 of the Clock that Night, it began to rain Sand or Aſhes, and continued till two of the Clock the next Morning. It was about two Inches thick on the Deck, ſo that we caſt it over-board with Shovels, as we did Snow the Day before. There was no Wind ſtirring when theſe *Aſhes* fell; it did not fall only in the Places where we were, but likewiſe in other Parts, as Ships were coming from *St. John d'Acre* to our Port; they being at that Time 100 Leagues from us. We compared the Aſhes together, and found them both one.

A Shower of Aſhes *in the* Archipelago; *by Capt.* Will Badily, n. 21. p. 377.

N. B. This Shower of Aſhes was upon an *Eruption* of Mount *Veſuvius*.

XL.

A Shower of Ivy Berries, *miſtaken for* Wheat; *by Mr.* W. Cole n. 188. p. 281.

XL. This City of *Briſtol* and the Country round, is filled with Reports of raining Wheat about *Warminſter* in *Wiltſhire*, and other Places within 6 or 8 Miles of it; and many believe it. I have procured ſeveral Parcels of it, and find it to be the Seed of *Ivy-Berries*, which from Towers and Churches, Chimneys, Walls, and high Buildings, were lately by very fierce Tempeſts of Wind and Hail driven away from the Holes, Chinks, and other Parts, where Birds had brought them, eſpecially *Sterlings* and *Choughs*. It was (among many other prodigious Stories) confidently affirmed, that thoſe Grains were found in the Hail, as Seeds in Comfits. I have by all ways I can imagine, examined and compared them with the Seeds of *Ivy-Berries*, by the Taſte, Smell, Size, and Figure, with the Aſſiſtance of *Magnifying Glaſſes*, viewing them in both the ſuperficial and inward Parts.

A Shower of Fiſhes *in* Kent; *by Dr.* Rob. Cony, n. 243. p. 289.

XLI. On *Wedneſday* before *Eaſter*, *An.* 1696. a Paſture Field at *Cranſtead*, near *Wrotham* in *Kent*, about two Acres, which is far from any part of the Sea, or Branch of it, and a Place where are no Fiſh-ponds, but a Scarcity of Water, was all over-ſpread with little Fiſhes, conceived to be rained down, there having been at that Time a great Tempeſt of Thunder and Rain. The Fiſhes were about the length of a Man's little Finger, and judged by all that ſaw them to be young Whitings; many of them were taken up and ſhewed to ſeveral Perſons. The Field belonged to one *Ware*, a Yeoman, who ſhew'd ſome of them, among others, to Mr. *Lake*, a *Bencher* of the *Middle-Temple*, who had one of them, and brought it to *London*. The Truth of it was averr'd by many that ſaw the Fiſhes lie ſcattered all over that Field, and none in the other Fields thereto adjoining. The Quantity of them was eſtimated to be about a Buſhel, being all together.

I had this Account from a worthy Gentleman of this Country, who had a Box full of the Fiſhes.

Hailſtones *of an extraordinary Bigneſs, by Dr.* Nath. Fairfax, n. 26. p. 481.

XLII. *July* 17, 1666. About ten in the Forenoon, there fell a violent Storm of *Hail* upon the Coaſt-Towns of *Suffolk*, tracing along *Seckford Hall*, *Woodbridge*, *Snape-Bridge*, *Aldborough*, &c. more to the Northwards. The *Hail* was ſmall near *Yarmouth*; but at *Seckford-Hall* one *Hail-ſtone* was found by Meaſure to be 9 Inches about. One of this Town (*viz. Woodbridge*) found one at *Melton* 8 Inches about. At *Snape-bridge* a Man affirmed, that he lighted on one about 12 Inches about. A Lady of *Friſton-Hall* putting one of them into a Balance, found it weigh 12 *s.* 6 *d.* Several Perſons of good Credit in *Aldborough* affirmed ſome *Hail-ſtones* to have been full as big as *Turkey*'s *Eggs* (an ordinary *Hen*'s Egg weighs but about 9 *s.*) *J. Baker* of *Rumbrough* had his Head broken by the Knocks of them through a ſtiff Country Felt; in ſome Places his Head bled, in others Bunneys aroſe: The Horſes were ſo pelted, that they hurried away his Cart beyond all Command. They ſeemed all white, ſmooth without, ſhining within. 'Tis ſomewhat ſtrange, methinks, that their Pillar of Air ſhould keep them aloft, if they were not clap'd together in the falling, eſpecially at ſuch a Time of the Year when the Air is leſs thickned, and its Springs weaker.

Large Hail-ſtones in Flanders; *by* -- n. 203. p. 858.

XLIII. In *May* 1686. there fell, at *Liſle* in *Flanders*, *Hail* of ſo great a Bigneſs, that the leaſt exceeded Pigeons Eggs. Several of them were a Quarter of a Pound Weight and more. One among the reſt was obſerved to contain a dark brown Matter in the Middle thereof; and being thrown into the Fire, it gave a very great Report. Others were tranſparent, which melted before the Fire immediately. This Storm paſſed over the Citadel and Town, and left not a whole Glaſs in the Windows on the windward Side. The Trees were broken, and ſome beat down; and the *Partridges* and *Hares* kill'd in Abundance.

Extraordinary Hail *in* Wales, Cheſhire, *&c.* *by Mr.* Edm. Halley, n. 229. p. 570.

XLIV. 1. A very extraordinary Hail fell in theſe Parts, *April* 29, 1697. The Vapours that diſpoſed the aqueous Parts thus to congeal, came with a South-weſt Wind out of *Caernarvanſhire*, paſſing near *Snowdon* with a horrid black Cloud, attended with frequent *Lightnings* and *Thunder*. As yet I hear no further of it Weſtward than out of *Denbighſhire*, where it left St. *Aſaph* to the Right, and did much Damage between it and the Sea, breaking all the Windows on the Weather-ſide, and killing Poultry and Lambs, and at Sir *John Conway*'s, at *Deſert*, a ſtout Dog; and in the North Part of *Flintſhire* ſeveral People had their Heads broke, and were grievouſly bruiſed on their Bodies. From *Flintſhire* it croſſed over the Arm of the Sea that comes up to *Cheſter*, and was only felt in *Cheſhire*, at the very *N. W.* Corner of the *Peninſula*, called *Wiral*, between the *Æſtuaria* of *Cheſter* and *Leverpoole*, at a Town called *W. Kirby*, where it hailed but for three Minutes, it being on the extreme Point thereof, on the Right-hand, but it thundred dreadfully, and was here at *Cheſter* about three in the Afternoon; but the main Body of it fell upon *Lancaſhire*, in a right Line from *Ormſkirk* to *Blackborn*, which is on the Borders of *Yorkſhire*; but whether it croſſed the Ridge of Hills into *Yorkſhire*, we know not. The Breadth of the Cloud was about two Miles; within which Compaſs it did incredible Damage, killing all Sorts of Fowl and ſmall Creatures, and ſcarce leaving any whole Panes in any of the Windows where it paſſed; but which is worſe, it plowed up the Earth, and cut off the Blade of the green Corn ſo as utterly to deſtroy it, the *Hail-ſtones* burying themſelves in the Ground; and the Bowling-Greens, where the Earth was any Thing ſoft, were quite defaced, ſo as to be rendred unſerviceable for a Time. This I had from an Eye-Witneſs. The *Hail-ſtones*, ſome of which weighed five *Ounces*, were of differing Forms, ſome round, ſome half-round, ſome ſmooth, others emboſſed and crenulated, like the Foot of a drinking Glaſs, the Ice very tranſparent and hard, but a *ſnowy Kernel* was in the midſt of moſt of them, if not all. The Force of their Fall argued them to fall from a great Height. What I take to be moſt extraordinary in this *Phænomenon* is, that ſuch a Sort of Vapours ſhould continue undiſperſt ſo long a Tract, as above ſixty Miles together, and in all the Way of its Paſſage occaſion ſo extraordinary a *Coagulation* and *Congelation* of the watry Clouds, as to encreaſe the *Hail-ſtones* to ſo vaſt a Bulk, in ſo ſhort a Space as that of their Fall.

By . . . ib. p. 512.

2. We had only the extreme Skirt of the Shower here, and there fell not above 10 *Hail-ſtones* in our Court; but they were much larger and harder than the oldeſt of us had ſeen. A Gentlewoman found one of them by Meaſure to be about 5 Inches about. A little while after the Shower was over, I found the *Stones* had fallen at good Diſtances one from another, and that they were melting very faſt, the Weather being very hot; ſcarce any of them was ſo little as a Muſket Bullet, but moſt of them far bigger, and of that Figure.

A Servant who was then at *Bottle-Mill*, tells me, That the Sea ſeemed to be riſen to an unwonted Height, and to bear the Appearance of a Wood; that he found *Hail-ſtones* as big as *Poot Eggs*; and that many Sea-Fowl and Land-Fowl were killed: And as an Inſtance of it, he took up a *Sea-Swallow* on *Bottle-Marſh*, whoſe Wing was broken with an icy Pellet, and brought her home. Upon this Story, I rid toward the Grounds which had ſhared moſt in the *Storm*. When I came to *Bottle*, I ſaw *Jane Mutche*'s Windows ill battered. I found the Storm had been as violent at *Linaker*; I ſaw what Breaches it had made upon *Will. Halſall*'s Barns, what Boughs it had broke off from his Apple-trees, and what Wounds the *Hail-ſtones* had made in the green Brow by his Houſe. I meaſured ſeveral of the Holes, and found them generally an Inch deep, and ſome an Inch and a half. *Will. Halſall* told me, that the great *Stones* fell ſo violently into the Marl-pit beſides his Houſe, that Spouts of Water roſe a Yard and a half high. This unriddled my Man's Story, that the Sea appeared like a Wood. Dr. *Tarleton* took up *Hail-ſtones* as big as *Duck Eggs* upon *Aughton Common*; and Mr. *Shepherd* profeſſes, that the Church-yard at *Sephton* ſeem'd as ſtrew'd with *Duck Eggs*; and that one of them was weighed, which amounted to full Half a Pound: Two *Hail-ſtones* were weighed at *Ormſkirk*, which came to ¼ of a Pound a-piece. At *Ince* the *Stones* were part as big as *Duck*, and part as *Gooſe Eggs*.

I ſent ſome People the next Morning early to the Sea-ſide, and they brought in ſeven Sorts of Fowls, as *Curlieu*, *Sea-Pye*, *Sea-Swallow*, *Gorre*, and other we want Names for: And we hear that at the little Towns next the Sea, they were pick'd up by Buſhels.

No *Hail* fell at *Everton*, *Lowhill*, or *Leverpoole*, the Storm ending near *Walton*; but there was ſo thick a Darkneſs before the Storm, that in *Leverpoole*, many People ran out of their Houſes into the Street to look at the Face of the Sky; and it was marvellous dark here. The Neighbours tell doleful Stories of the Effects of this Hail: As a young Woman at *Bottle* was running for Shelter, her Hat fell off, and a *Hail-ſtone* that hit her behind the Ear made her tumble; a Man was knock'd off his Horſe by the *Hail*, but preſently got up again: Another having pull'd down his Hat to ſave his Face, a *Stone* fell which tore the Brim from the Crown, ſo far that he could put his Hand through the Hole: At *Ormſkirk* 4 Pounds Damage was done to one Inn, and the Glaſs broke by the Storm in the whole Town, could not be repaired for 60*l*. The Stones there rebounded, many of them 2 Yards high; at *Ince* two Horſes were knock'd down in the Plough, and a Man fell at the ſame Time; at *Croſby* ſome Beaſts were knock'd down; one *Jo. Holland* was found dead in *Skirmſdale* after the Shower, but whether by the *Hail* or *Lightning* (for it came with *Thunder* and *Lightning*) I have not yet heard: Two Women were ſo beaten by it, in a little while before they got Cover, that they could hardly turn them in their Beds next Morning; they could hardly paſs the Lanes for Baſkets, Panniers, Sacks, and People, which the Horſes had thrown down in their Return from *Ormſkirk* Market.

A Storm of Hail *in* Hertfordſhire, May 4, 1697. *by Mr.* Rob. Taylor, *ib.* p. 577.

XLV. On *Tueſday*, *May*, 4, 1697. (at *Hitchin* in *Hertfordſhire*) about nine a-Clock in the Morning, it began to lighten and thunder extremely, ſome great Showers intervening; it continued till about two of the Clock in the Afternoon, when on a ſudden, a black Cloud aroſe *S. W.* of us, the Wind being Eaſt, and blew hard; then fell a ſharp Shower, with ſome *Hail-ſtones*. I meaſured ſome of them 7 and 8 Inches about: But the Extremity of the Storm fell about *Offley*, where a young Fellow was kill'd, one of his Eyes ſtruck out of his Head, his Body was all over black with the Bruiſes; another Perſon nearer to *Offley* eſcaped with his Life, but much bruiſed. There was in the Houſe of Sir *Jo. Spencer*, 7000 Quarries of Glaſs broke, and there was great Damage done to all the neighbouring Houſes thereabouts. The Hail fell in ſuch vaſt Quantities, and ſo great, that it tore up the Ground, ſplit great Oaks and other Trees in great Numbers; it cut down great Fields of *Rye*, as with a Scythe, and has deſtroy'd ſeveral hundred Acres of Wheat, Barley, *&c.* inſomuch that they plough it up and ſow it with Oats. The *Tempeſt* was ſuch when it fell that in 4 Poles of Land, from the Hills near us, it carried away all the Staple of the Land, leaving nothing but Chalk. The *Hail* broke vaſt Numbers of Pigeons Wings, Crows, Rooks, and other Birds: The Flood came down, ſpreading 4 or 5 Acres of Land, rowling like the Bay of *Biſcay*; and which is very ſtrange, all this fell in the Compaſs of one *Engliſh* Mile. I was walking in my Garden, which is very ſmall, perhaps about 30 Yards Square, and before I could get out, it took me to my Knees, and was through my Houſe before I could get in, which I can modeſtly ſpeak was in the Space of a Minute, and went through all like a Sea, carrying all Wooden Things like Boats on the Water, the greateſt Part of the Town being under this Misfortune; the Surpriſe was ſo great, that we had ſcarce Time enough to ſave our Children and Wives. There fell ſome hundred thouſand Cart-loads: I ſaw them 4 Days after; and if the Beds of *Hail* had not been broke by Peoples coming, and trampling of Horſes, it might have lain till *Michaelmas*. They have been meaſured from one to thirteen and fourteen Inches certain: Some People talk largely of it, ſeventeen and eighteen Inches; but the other is certain Truth. The Figures of them are various, ſome oval, others round, others pricked, ſome flat. We were not ſo curious to weigh them. The Damage about us, and in our Town, is near 4000 *l.*

A Storm of Hail *in* Herefordſhire, June 6, 1697. *by* - - ib. p. 579.

XLVI. 1. In the Pariſh of *Weſtbide*, not far from *Hereford*, there fell, on the 6th *June*, 1697. ſo great a Quantity of *Hail*, that it deſtroy'd all the Poultry, Garden-ſtuff, Corn, Graſs, and moſt of the Fruit-trees in the Pariſh, but killed no Men nor Cattle; but hurt ſeveral, and broke moſt of the Windows. Many of the Stones were meaſured above nine Inches in Compaſs.

By Mr. Edw. Lhwyd, *ib.* 2. We had at *Ponty-Pool* in *Monmouthſhire*, *June* 1697. an extraordinary Shower of *Hail*, which extended about a Mile, and laſted near half an Hour. It broke the Stalks of all the Beans and Wheat within that Circumference, and ruined as much Glaſs at Major *Hanbury*'s Houſe, as coſt four Pounds repairing; ſome of the *Hail* were eight Inches about, their Figure very irregular and unconſtant, ſeveral of the *Hail-ſtones* being compounded.

An unuſual Sort of Snow; *By Mr.* Joh. Chr. Beckman, n. 39. p. 773. XLVII. The firſt of *March*, 166$\frac{7}{8}$. there fell an unuſual Sort of Snow at *Frankfort* in the *Oder*: It had none of the ordinary Figures, but was made up of little Pillars, whereof ſome were *Tetragonal*, ſome *Hexagonal*, with a neat *Baſis*. On the Top they were ſomewhat larger, as the *Heads of Columns* are Conſidering the whole Shape, we thought fit to give it the Name of *Nix Columnaris*.

Red Snow *near* Genoa; *communicated by* Sig. Sarotti, n. 139. p. 976. XLVIII. On St. *Joſeph*'s Day, upon the Mountains called *Le Langhe*, there fell upon the white Snow that was there already, a great Quantity of red, or if you pleaſe, of Bloody Snow; from which (being ſqueez'd) there came a Water of the ſame Colour.

Obſervations on Snow; *by Dr.* J. Beale, n. 56. p. 1138. XLIX. I have ſeen the Water of diſſolved Snow perform a quick Cure, in taking out the Fire, when the Fleſh was burnt by a Warming-pan of Braſs, which Metal commonly makes the Burning more difficult to be cured: Which did put me in Mind to examine the Figures of the Snow which now fell in this extreme Froſt. I expected that we might ſee through the ſmall Particles at leaſt as through Lice, Fleas, Cheeſe-mites, *&c.* by ſome kind of Tranſparence: But I was deceived; my Aſſiſtants could make nothing of it, either by an ordinary or extraordinary Microſcope.

The Nature of Snow; *by Dr.* Nehem. Grew, n. 92. p. 5193. L. He that will enquire of the Nature of Snow, will do it beſt, not by the Purſuit of his Fancy in a Chair, but with his Eyes abroad; where if we uſe them well fixed, and with good Caution, and this in a thin, calm and ſtill Snow, we may by Degrees obſerve,

1. With M. *Des Cartes* and Mr. *Hook*, that many Parts hereof are of a regular Figure, for the moſt Part, as it were, ſo many little Rowels, or Stars, of ſix Points, being perfect and tranſparent *Ice*, as any we ſee upon a Pool or Veſſel of Water. Upon each of theſe ſix Points are ſet other collateral Points, and thoſe always at the ſame Angles as are the main Points themſelves.

2. Amongſt theſe regular Figures, many others alike regular, but far leſs, may likewiſe be diſcovered.

3. Looking ſtill more warily we ſhall perceive, that there are divers others indeed irregular, yet chiefly but the broken Points, Parcels and Fragments of the regular ones.

Laſtly, That beſides the broken Parts, there are ſome others which ſeem to have loſt their Regularity, not ſo much in being broken, as by various Winds firſt gently thaw'd, and then froze into little irregular Clumpers again.

From whence the true Notion, and external Nature of *Snow*, ſeemeth to appear, *viz.* That not only ſome few Parts of *Snow*, but originally the whole Body of it, or of a *ſnowy* Cloud, is an infinite Maſs of *Iſicles* regularly figur'd; not one Particle thereof, I ſay, originally, not one of ſo many Millions, being indeterminate or irregular; that is to ſay, a Cloud of Vapours being gathered into Drops, the ſaid Drops forthwith deſcend; upon which Deſcent, meeting with a ſoft freezing Wind, or at leaſt paſſing through a colder Region of the Air, each Drop is immediately froze into an *Iſicle*, ſhooting it ſelf forth into ſeveral Points or *Striæ* on each Hand from-ward its Center: But ſtill continuing their Deſcent, and meeting with ſome ſprinkling and intermixed Gales of warmer Air, or in their continual Motion, and Waftage to and fro, touching upon each other, ſome are a little thaw'd, blunted, froſted, clumper'd, others broken, but the moſt hanked and clung in ſeveral Parcels together; which we call *Flakes of Snow*.

Hence we underſtand *why Snow*, though it ſeems to be ſoft, yet is truly hard, becauſe true *Ice*, the inſeparable Property whereof is to be hard; ſeeming only to be ſoft, becauſe upon the firſt Touch of the Finger upon any of its ſharp Edges or Points they inſtantly thaw, or otherwiſe they would pierce our Fingers as ſo many Lancets.

Why again, though it be true *Ice*, and ſo hard and denſe a Body, yet 'tis very light; becauſe of the extream Thinneſs of each *Iſicle* in Compariſon of its Breadth: For ſo Gold, which, though of all Bodies the moſt ponderous, yet being beaten into Leaves, rides upon the leaſt Breath of Air.

Alſo how it is White; becauſe conſiſtent of Parts all of them ſingly tranſparent; but being mixed together appear white, as the Parts of Froth, Glaſs, Ice, and other tranſparent Bodies, whether ſoft or hard.

The *eſſential Nature of Snow*, I think may be beſt underſtood, by comparing its general Figure with ſuch regular Figures as we ſee in divers other Bodies; in that where we ſee the like Configurations, we may believe there is the like *Subject* wherein, or the like *Efficient* whereby, both thoſe and theſe are made.

As for the *Figure of Snow*, 'tis generally one, *viz.* That which is above deſcribed; rarely of different ones, which may be reduced chiefly to two Generals, Circulars and Hexagonals either ſimple or compounded together: More rarely, either to be ſeen of more than ſix Points, but if ſo, then not of eight or ten, but twelve: Or in ſingle Shoots, as ſo many ſhort ſlender Cylinders like thoſe of *Nitre*: Or by one of theſe Shoots, as the Axle-tree, and touching upon the Center of a Pair of pointed *Iſicles*, joined together as the two Wheels: Or the ſame Hexagonal Figure, and of the ſame uſual Breadth, but continued in Thickneſs or Profundity, like the Stone, which, as I remember, *Boetius* calls *Aſtroites*. All theſe I ſay are rare, the firſt deſcribed being the general *Figure*.

As for the *Configurations* of other Bodies, we ſhall find, that there are divers, which have ſome a leſs, others a more near Reſemblance hereunto.

Nitre is formed, as is commonly known, into long Cylindrical Shoots, as alſo all *Lixivial Salts*, for the moſt Part; reſembling, though not perfectly, the ſeveral Points of each ſtarry *Iſicle* of *Snow*. *Salt* of *Harts Horn*, *Sal Armoniac*, and ſome other *Volatile Salts*, beſides their main and longer Shoots, have others ſhorter branched out from them; reſembling, as thoſe the main, ſo theſe the collateral Points of Snow. But the *Iſicles* of *Urine* are ſtill more near: For, in *Salt* of *Harts Horn*, although the collateral Shoots ſtand at acute Angels with the main, yet not by Pairs at equal height; and in *Sal Armoniac*, although they ſtand diametrically oppoſite, or at equal Height, yet withal at Right, not Acute Angles; whereas in the *Iſicles* of *Urine* they ſtand at equal Height, and at Acute Angles both: In both, like thoſe of *Snow*. And it is obſervable, that the *Configuration* of *Feathers* is likewiſe the ſame; the reaſon whereof is, becauſe Fowls having no Organs for the Evacuation of *Urine*, the *urinous* Parts of their Blood are evacuated by the Habit or Skin, where they produce and nouriſh *Feathers*.

From hence it ſhould ſeem, That every Drop of Rain aforeſaid, containing in it ſelf ſome *ſpirituous* Particles (as from the Height to which they are advanced, the prolifick Virtue of *Rain*, and its eaſy Tendency to Putrefaction above other Water, is argued they do) and meeting with others in their Deſcent of a *Saline*, and that partly *Nitrous*, but chiefly *Urinous*, or of an *Acidoſalinous* Nature, the ſaid *ſpirituous* Parts are apprehended by them, and with thoſe the Watry, and ſo the whole Drop is fixed; yet not into any indifferent and irregular Shape, depriving the *ſpirituous* Parts of their Motion in an inſtant; but according to the *Energy* of the *Spirituous*, as the Pencil, and the ſpecifick Nature, or determinate Poſſibility of the *Saline* Parts, as the Ruler, 'tis thus figured into a little Star.

A Freezing Rain *in* Somerſetſhire; *by Dr.* J. Beale, n. 90. p. 5138.

LI. 1. The *Freezing Rain*, which fell here the 9th, 10th, or 11th, of *December*, 1672. (for I cannot confine the Time exactly) hath made ſuch a Deſtruction of Trees, in all the Villages and Highways from *Briſtol* towards *Wells*, and towards *Shepton-Mallet*, and towards *Bath* and *Bruton*, and in other Places of the *Weſt*, that both for the Manner and Matter it may ſeem incredible, and is more ſtrange than I have found in any *Engliſh* Chronicle. You have the Proof and Manner, and beſt Meaſure of it in the following Tranſcript: " The late prodigious *Froſt* (*ſaith a very worthy* " *Perſon of unqueſtionable Credit*) hath much diſabled many old Orchards, " expoſed to the North-eaſt; had it concluded with ſome Guſts of Wind " it might have been of ſad Importance; I weighed the Sprigg of an Aſh- " Tree of juſt three Quarters of a Pound, which was brought to my " Table; the *Ice* on it weighed 16 Pounds, beſides what was melted off " by the Hands of them that brought it. A very ſmall Bent at the ſame " Time was produced, which had an *Iſicle*, encompaſſing it, of 5 Inches " round by meaſure. Yet all this while, when Trees and Hedges were " loaden with *Ice*, there was no *Ice* to be ſeen on our Rivers, nor ſo much " as on our ſtanding Pools." The like, or worſe, and more ſtrange Complaints,

plaints, I received from ſeveral other Places, and from Eye-Witneſſes of Credit. Some Travellers were almoſt loſt by the Coldneſs of the *Freezing* Air, and *Freezing* Rain. All the Trees, young and old, on the Highway from *Briſtol* to *Shepton*, were ſo torn and thrown down on both ſides the Ways, that they were unpaſſable. By the like Obſtructions the Carriers of *Bruton* were forc'd to return back. Some were affrighted by the Noiſe in the Air, till they diſcern'd that it was the clatter of *Icy* Boughs, daſhed one againſt another by the Wind. Some told me that riding on the Snowy Downs, they ſaw this *Freezing Rain* fall upon the Snow; and immediately *freeze* to *Ice*, without ſinking at all into the Snow; ſo that the Snow was covered with *Ice* all along, and had been dangerous, if the *Ice* had been ſtrong enough to bear them. Others were on their Journey when the *Ice* was able to bear them in ſome Places, and they were in great Diſtreſs.

Dec. 8. Much Snow fell here; the 9th much *Rain* fell here; and all the Snow paſſed away, not leaving an *Iſicle* amongſt us. The 10th Day, we had ſudden Fits of Cold and relaxing Warmneſs. On *Wedneſday* (*Dec.* 11.) I ſaw a young Man, who returning home from a Journey of 5 Miles, and coming into a warm Room, cry'd out of extreme Torments in all Parts of his Body. He affirm'd, that the Air, and the Winds (which were then ſomewhat high) were ſo unſufferably cold, that he was in utter Deſpair of coming home alive; yet all that Day nothing but moiſt Dew fell under our Feet. If we ſay, the Earth did ſend forth warm Steams to keep this *Freezing Rain* diſſolved on her Surface; whence ſhall we ſay, the Air, and Rain, and Winds, got theſe *Freezing Iſicles* which oppreſſed Men and Plants? When the Canded *Froſts* do cover our Fruit-Trees perfectly white (as I have oft-times ſeen it hold for ſome Weeks together) it is ſo far from doing hurt to the Trees, that we have it in a Proverb, for a good Sign of abundance of Fruit, in the enſuing Year. But this *Freezing Rain*, as ſoon as it touched any Bough, ſettled into *Ice*, and by multiplying and enlarging the *Iſicles* (eſpecially where it could lay hold on Moſs, or other Aſperities of the Tree) it broke all down with the Weight.

This ſhews that a *Froſt* may be very fierce and dangerous in the Air, and n. 116.
on the Tops of ſome Hills and Plains, whilſt in many other Places it keeps p. 357.
at two, three, or four Foot diſtance above the Ground, Rivers and Lakes; and many wander, at ſome Difference of Time, in ſome Places very furious; in other Places intermediate and not far aſunder, very remiſs and abated; where it was fierce, always at the Height of Trees at leaſt, never on the Ground vehement, that I could hear of, but on *Saliſbury Plains*, which are very high Grounds.

As ſoon as theſe *Froſts* were over, we had *glowing Heats*, which cauſed a n. 90.
general Complaint amongſt us of exceſſive Sweating, by Night and Day. p. 514.
The Buſhes, and many Flowers in the Garden, appeared in ſuch forwardneſs, as if it were in *April* or *May*. I ſaw young Coleworts growing; and not far from my Abode, an Apple-tree bloſſomed before *Chriſtmas*. This I do not mention for extraordinary; but I think 'tis more than ordinary, that before

New-Tears-Tide this Apple-tree bore Apples perfectly knitted, and as big as one's Finger's End.

At Oxford; by Dr. Wallis, n. 92. p. 5195. n. 231. p. 654. 2. The like ſtrange Froſt was with us at *Oxford.* It was rather a *Raining* of *Ice*, or at leaſt *Rain Freezing* as it fell; which made ſtrange *Iſicles* hanging on Trees, and a ſtrange Noiſe by the rattling of them upon the Boughs Motion by the Wind; but not ſo much as at the Places you mention in *Somerſetſhire:* Yet more in the Country about us (as from ſeveral Relaters I have heard) than with us here. And the great *Warmth* ſoon after was alſo with us; inſomuch that not only Bloſſoms, but (as was then certainly affirmed, though I was not ſo curious as to get a Sight of any) green Apples were obſerved on divers Trees, particularly in the Pariſh of *Holywell.*

Effects of Cold in the Northern Countries; by Mr. J. Scheferus, n. 19. p. 350. LII. 1. Mr. *John Schefferus*, a Profeſſor in the *Swediſh Univerſity* at *Upſal*, writes, That he had ſeen and had *Hares*, which about the Beginning of *Winter* and *Spring* were half *white* and half of their native Colour: That in the midſt of *Winter* he never ſaw any but all *white*. That *Foxes* alſo were *white* in *Winter*, and *Squirrels* greyiſh, mix'd of a *dark* and *white* Colour.

That Fiſhes are killed by reaſon of the *Ice* not being broken: But firſt, in Ponds only, or narrow Lakes; next, in ſuch Lakes only where the *Ice* is pretty thick; for, where 'tis thin, they die not ſo eaſily. Laſtly, That thoſe Fiſhes that lie in ſlimy or clay Ground die not ſo ſoon as others.

That in great Lakes, when 'tis a very bitter *Froſt*, *Ice* is wont to be broken either by the Force of the Waves, or of the impriſoned Vapours, raiſed by the Agitation of the Water, and then burſting out with an Impetuoſity; witneſs the Noiſe made by the Rupture of the *Ice* through the whole Length of ſuch Lakes, which he affirms to be not leſs terrible than if many Guns went off together; whereby it falls out, that *Fiſhes* are ſeldom found dead in great Lakes.

That neither Oil nor a ſtrong Brine of Bay-Salt, is truly congealed into *Ice* in thoſe Parts: That the *Froſt* pierces into the Earth two Cubits or *Swediſh Ells*, and what Moiſture is found in it, is white, like *Ice*. That Waters, if ſtanding, *freeze* to a greater Depth, even to three ſuch *Ells* or more; but thoſe that have a Current, leſs: That rapid Waters *freeze* not at all, nor ever bubbling Springs; and that theſe latter ſeem even to be warmer in Winter than in Summer.

By M. Febre ib 531. 2. M. *Febre*, Chief Secretary to Prince *Radzivil*, aſſures us, that in the War againſt the *Muſcovites* and *Coſſacks* in *Jan.* 1655. at the Siege of *Bichow* in *White Ruſſia*, all their Proviſions of *Spaniſh Wines* or *Peterſimen*, and Beer, were in one Night *frozen* upon the Sledge, notwithſtanding they were covered with Straw; inſomuch that they were conſtrained to carry them into a Stove to thaw them, which they could not do in two whole Days, and were obliged to break the Veſſels, and put Pieces of the *Ice-Wine* into Kettles, to thaw them over the Fire for Drink. But he obſerved that the *Hungarian Wine* reſiſted the Cold better than the *Peterſimen*; for it was not ſo much *frozen*, unleſs it be that the Butler tranſported it ſooner into the Stove. That the Scrue of a Flagon of *Aqua Vitæ* being put to his Mouth, ſtuck cloſe to his Lips that he could not draw it off without drawing Blood.

That the Pool of the Village (where they quartered) was ſo thoroughly *frozen*, that there was but very little Water left between the *Ice* and the Bottom.

That *Jan.* 2, 1665 the *Froſt* was ſo bitter in *Poland*, that three Soldiers dy'd of it in paſſing a long Ditch; and that divers Perſons loſt ſome of their Limbs. *Ib.* p. 352.

LIII. 1. The paſt *Winter* 168$\frac{3}{4}$ has been ſo ſevere in my Territories, that where it could, it expugned the more defenſible, and ſuch as were incloſed, and it has ravag'd all that lay open, and were abroad, without any Mercy. *The Effects of the* Froſt, 1683-4; *by Mr.* J. Evelyn, n. 158. p. 559.

As to *Timber-Trees*, I have not many here of any conſiderable Age or Stature, except a few *Elms*, which (having been decayed many Years) one cannot well find to have received any freſh Wounds, diſtinguiſhable from old Cracks and Hollowneſſes; and indeed I am told by divers, that *Elms* have not ſuffered as the great *Oaks* have done; nor do I find, amongſt innumerable of that Species (*Elms*) which I have planted, and that are now about twenty-five and thirty Years ſtanding, any of them touched: The ſame I obſerve of *Limes*, *Walnuts*, *Aſh*, *Beach*, *Horn-beams*, *Birch*, *Cheſnut*, and other Forreſters. But, as I ſaid, mine are young comparatively; and yet one would think, that ſhould leſs protect them, becauſe more tender: So as it ſeems the Rifting ſo much complain'd of, has happen'd chiefly among the overgrown Trees, eſpecially *Oaks*. My Lord *Weymouth* made his Lamentation to me, and ſo has the Earl of *Cheſterfield*, Lord *Ferrers*, Sir *William Fermor*, and others concerned in the ſame Calamity; which I mention, becauſe of their diſtant Habitations. But if rightly I remember, one of theſe noble Perſons lately told me, that ſince the *Thaw*, the Trees, which were exceedingly ſplit, were come together and cloſed again; and I eaſily believ'd it: but that they are really as ſolid as before, I doubt will not appear, when they ſhall come to be examined by the Ax, and converted to Uſe. Nor has this Accident happen'd only to ſtanding Timber, but to that which has been fell'd and ſeaſon'd, as Mr. *Shiſh*, the Maſter-builder in his Majeſty's Ship-Yard here inform'd me.

As for *Exoticks*; I fear my *Cork-Trees* will hardly recover. The *Conſtantinopolitan* or *Horſe-Cheſnut* is turgid with Buds, and ready to explain its Leaf. My *Cedars*, I think, are loſt: The *Ilex* and *Scarlet-Oak* not ſo: The *Arbutus*, doubtful, and ſo are *Bays*; but ſome will eſcape, and moſt of them repullulate and ſpring afreſh, if cut down near the Earth, at the latter End of the Month. The *Scotch-Fir*, *Spruce*, and white *Spaniſh* (which laſt uſes to ſuffer in its tender Buds by the *Spring-Froſts*) have received no Damage this *Winter*; I cannot ſay the ſame of the *Pine*, which bears the greater Cone, but other *Norways* and *Pinaſters* are freſh. *Laurel* is only diſcoloured, and ſome of the woody Branches mortified, which being cut to the Quick, will ſoon put forth again, it being a ſucculent Plant. Amongſt our *Shrubs*, *Roſmary* is intirely loſt; and ſo univerſal (I fear) is the Deſtruction of this excellent Plant (not only over *England*, but our neighbour Countries more Southward) that we muſt raiſe our next Hopes from the Seed: *Halimus*) or Sea-Purſlain (of which I had a pretty Hedge) is alſo periſhed, and ſo another of *French-Furſes*; The *Cypreſſes* are all of them ſcorched, and ſome to Death, eſpecially ſuch as were kept ſhorn in Pyramids; but amongſt great Numbers, there will divers eſcape, after they are well *chaſtiz'd*, that is, with a tough Hazel or other Wand, to beat off their dead and duſty Leaves, which, growing much cloſer than other Shrubs, hinder the Air and Dews from refreſhing the interior Parts. This Diſcipline I uſe to all my *Tonſile Shrubs* with good Succeſs, as oft as a Winter parches them. The Berry-bearing *Savine* (which, if well underſtood and cultivated, were the only beſt *Succedaneum* to *Cypreſs*) has not ſuffered in the leaſt; it perfectly reſembles the *Cypreſs*, and grows very tall and thick. I think the *Arbor Thuya* is alive, and ſo is the *American Acacia*, *Acanthus*, *Paliurus*, *Pomgranate*, my *Lauruſtinus* looks ſuſpiciouſly: Some large and old *Alaturnus's* are kill'd, eſpecially ſuch as were more expoſed to the Sun, whereas thoſe that grow in the Shade eſcape; the Reaſon of which I conjecture to be, from the Reciprocations of being ſomewhat relaxed every Day, and then made rigid and ſtiff again all Night, which bending and unbending ſo often, opening and cloſing the Parts, does exceedingly mortify them, and all other tender Plants; whilſt thoſe which grow in ſhady Places, undergo but one Thaw and Change. Moſt of theſe will yet revive again at the Root, being cut cloſe to the Ground. The *Phillyrea's*, *Auguſti*, and *Serratifolio's* (both of them incomparably the beſt for ornamental Hedges of any of the *Perennial Greens* I know) have hardly been ſenſible of the leaſt Impreſſion, more than tarniſhing of their Leaves: no more have the *Spaniſh Jaſmines*, and *Perſian*; and I enumerate theſe Particulars the more minutely, that Gentlemen who are curious, may take notice what Plants they may truſt to abroad, in all Events; for I ſpeak only of ſuch as are expoſed.

I need ſay nothing of *Holly*, *Yew*, *Box*, *Juniper*, &c. (hardy and ſpontaneous to our Country) and yet to my Grief I find a *Holly* Standard of near an hundred Years old, drooping, and of doubtful Aſpect; and a very beautiful Hedge (tho' indeed much younger) being clipp'd about *Michaelmas*, is mortified near a Foot beneath the Top, and, in ſome Places to the very Ground; ſo as there's nothing ſeems Proof againſt ſuch a *Winter*, which is late cut and expos'd. This Hedge does alſo grow againſt the South, and is very ruſſet, whilſt the contrary Side is as freſh and geeen as ever; and in all other Places of my Plantations that are ſhaded, the unſhorn *Hollies* maintain their Verdure, and are, I judge, impregnable againſt all Aſſaults of *Weather*.

Among the *Fruit-Trees*, and *Murals*, none ſeem to have ſuffer'd ſave *Figs*; but they being cut down, will ſpring again at the Root. The *Vines* have eſcaped, and of the *Eſculent Plants* and *Salads* moſt, except *Artichokes*, which are univerſally loſt; and what I prefer before any *Salad* whatever eaten raw, when young, my *Sampire* is all rotted to the very Root: How to repair my Loſs, I know not, for I could never make any of the Seed, which came from the *Rock Sampire* (tho' mine were of the very kind) to grow.

The *Arboreſcent* and other *Sedums*, *Aloes*, &c. (tho' hous'd) periſhed with me; but the *Yucca* and *Opuntia* eſcaped. *Tulips* many are loſt, and ſo the *Conſtantinope Narciſſus*, and ſuch *Tuberoſe* as were not kept in the Chimney-Corner, where was continual Fire. Some *Anemonies* appear, tho', I believe, many are rotted: But I have made no great Search in the flowery Parterre;

only I find that moſt Capillaries ſpring, and other humble and repent Plants, notwithſtanding all this rigorous Seaſon.

My *Tortoiſe* (which, by his conſtant burying himſelf in the Earth at Approach of Winter, I look upon as a kind of Plant-Animal) happening to be obſtructed by a Vine-Root, from mining to the Depth he was uſually wont to inter, is found ſtark dead, after having many Years eſcaped the ſevereſt Winters. Of *Fiſh* I have loſt very few; and the Nightingales (which, for being a ſhort-winged Bird, an ſo exceeding fat, at the Time of the Year, we commonly ſuppoſe to change the Climate; whereas indeed they are then hardly able to fly an hundred Yards) are as briſk and frolick as ever, nor do I think they alter their Summer Stations, whatever becomes of them all Winter.

By Mr. Jacob Bobart. n. 165. p. 766.

In this rigid Seaſon nothing ſeemed more ſurpriſing to us, nor more generally known to be true, than the cleaving or *ſplitting* of Trees; as of the *Elms* by Mr. *Langley*'s Houſe, the Miniſter of *Tamworth*, and *Aſhes* of conſiderable Bulk and Value, deſigned for, and capable of divers Uſes, as *Wind-Mill-Poſts*, Dreſſer-Boards, and other neceſſary Occaſions. Alſo *Wallnut-Trees* in divers Places have ſuffered by this Calamity, and proved extremely *cleft*; though indeed it hath been moſt frequent among *Oaks*, many of which have been divided to great Detriment in *England*, ſome being ſo rent, that a Man may ſee through them, and that many times the Cracks came with ſo great Noiſe, that as it is related from *Needwood-Foreſt*, they made ſuch a Noiſe, that the Keepers there thought that the Deer were ſhot by the People of the Country; and that in ſeveral Parts they were heard as loud as Guns, ſome having been cruelly affrighted, eſpecially in the Evenings or Nights, as they have paſſed within the Hearing of this ſo unexpected and ſurprizing a *Noiſe*. Which *Rifts* or *Clefts* were not at all to the ſame Point of the Compaſs, but ſometimes on one ſide only, ſometimes two, and ſometimes three, and ſometimes four ſeveral Places, dividing or quartering the Tree, and ſometimes quite through: and theſe *Clefts* were not only in the Bodies, but continued into the larger Boughs and Limbs of the Tree, and ſometimes deſcended into the ſuperficial Roots, but not to thoſe very deep in the Earth; the *Froſt*, though extreme, not reaching conſiderably deep, comparatively to the *Roots* of *Trees*, and the hard binding of the Earth being ſo *frozen*, would not eaſily admit of Compreſſure: But ſeveral ſhallow *Roots*, ſo knotted and knurled, as not to be wrought upon with Beetle and Wedges, are known to be *cleft* by the *Froſt*. But it is much to be doubted and ſuſpected, whether any ſuch *cloven* Trees were ſo perfectly ſound and faithful Timber, if proved by the Saw and Ax, as they ought to be; for, if ſo, all might equally ſuffer, the Air having impartial Acceſs to one as well as the other; but ſome being taken with this Diſeaſe, and others left untouch'd, there certainly was ſome Cauſe or Defect in thoſe liable to it, rather than the reſt. A great Part of the Cauſe of it is ſuppoſed to be Imperfection in ſuch a Tree, and that generally from the too large *Sap-Veſſels* and unnatural Cavities therein, which ſome call *Wind-ſhaken*, and ſome *lagg'd* Trees; the Cauſe whereof remains yet to be examined, whether the *ſhaking* of the Wind may not, with its great Weight and Force, taking the whole Tree with its Boughs, Limbs and Body, having one End firmly fixed in the Earth, at ſome Age or other, as well work wrack, and make Splintering and ſtretched Pores, Paſſages, Cavities, and ſuch like, in a live and growing Tree, at ſome times of Continuance of its Force with its oft repeated beating, twiſting, and preſſing Blaſts; as well as the beſt choſen Maſt of a Ship may ſuffer Damage by the ſame Cauſe, even to total Fraction. By ſome this is ſuppoſed to proceed from Earthquakes, but whether or not, is yet to be examined. But the Opinion of ſome ſeems not to be extravagant, who think it to be an original Diſtemper in the Tree, and to proceed from the *Soil*, or rather an innate Diſeaſe, from ſome, though undiſcernible Imperfection in the *Seed* it ſelf, and yet not ſo much but that they live many Years, and grow to great Bulk and Stature, being obſerved to bear leſſer Leaves and ſmaller Acorns; but whether the *Soil* be concerned, it may be urged, that the Trees about *Oxford* Weſtward, are generally affected with this Diſeaſe, and thoſe from the Eaſt-ſide prove excellent ſound Timber, tho' the *Soils* ſeem to reſemble one another.

But by what Means ſoever this may come, it is certain that ſome Trees are much more ſound than other, and that ſome prove full of inbred Diſeaſes and Cavities, before they are cut down, which Cavities and ſtretch'd Veſſels being fill'd with too great a Quantity of aqueous and undigeſted *Sap*, as it were *hydropical*, (for it is thought that the genuine and natural *Sap* of theſe our native Trees, though undergoing Condenſation, will remain ſecure and ſafe; as may be ſuppoſed from thoſe that are well and firmly ſtanding) are thereby rendred capable of not only Condenſation but *Glaciation* alſo by the Continuance and Severity of the Air's *frigefactive* Power; which being ſufficiently known to employ more Room being *Ice*, than formerly Liquid, might probably cauſe theſe *Breaches*; and if we conſider the expanſive Motion and Spring of the Air included in the Cavities of the *Air Veſſel*, ſuffering more Preſſure than they are patient of, from the *coagulated* and contiguous aqueous Parts then *congealed*, we may be induced to ſuppoſe theſe *ſtrepitous* Eruptions to proceed from thence. But whether Mr. *Hobbs*'s Hypotheſis will certainly hold, that the Swelling is cauſed by the Intruſion of the Air, is ſomewhat to be doubted.

It need not prove troubleſome to any to think the *Ice* to be able to *tear* the *Oaks* or other Trees, who ſhall conſider the great Force and elaſtick Power thereof; whereof that moſt excellent and curious Philoſopher of our Age, Eſquire *Boyle* hath, in his *Hiſtory of Cold*, ſet forth ſeveral Experiments and Examples; as Veſſels of ſeveral Kinds of Metals being made ſtrong on purpoſe, and fill'd with Water, cloſe ſtopp'd, and expoſed to the *Cold*, which being not capable of withſtanding the expanſive Force of the incloſed *Ice*, have been found *cleft* and broken; as for Inſtance, the ſtrong Barrel of a Gun cloſe ſtopped, with Water in it, and *frozen*, hath proved rent longways, and never acroſs the Veſſel, nor Bodies of the Trees we here mention. Another time a Braſs Veſſel of a Cylindrical Form being made not more than five Inches deep, and not two Diameter, filled with Water, and afterwards *frozen*, in one Night lifted off the Cover prepar'd and cloſely

fitted,

ſitted, with a Weight of fifty-ſix Pounds that was laid upon it. *Olearius*, Secretary to the Duke of *Holſtein*'s Embaſſy into *Ruſſia*, tells us, that in the City of *Moſcow* he obſerved, (the *Cold* being very intenſe) the Earth to be cleft many Yards in length, and a Foot broad, which according to Conjecture, was occaſioned by the Heaving and Swelling thereof to enlarge its Room, as here we ſee Ice crackt and cleft conſiderably long and broad, according to its Thickneſs along the Ridge or turgid Part thereof. And that the Earth doth ſo riſe when frozen, is eaſily made manifeſt, by little Sticks or Plants ſet into the Ground againſt the approaching Winter, which being riſen two or three Inches, or more, according to the Depth and Strength of the Froſt, and, upon the Thaw, the Earth ſinking to its former Station, leaves the unfixed Plants, with their Roots naked, above Ground, as it were, ſpewed out. And not ſuch moiſt Bodies only, but Metals, as Braſs, Iron, *&c.* have been ſwelled in the Time of being frozen, as hath been proved by Clocks, Locks, and other Inſtruments, and become laxed and pliant again upon the Thaw. Many more Examples might be eaſily produced to induce us to the Thoughts, that the Sap is not right and genuine in ſuch ill-diſpoſed Trees, and that Ice might, upon due Examination, be found in any ſuch burſten Bodies, as we are informed have been found and obſerved by ſome; and if Ice, then Preſſure; and if Preſſure, then Breaking and Exploſion.

It may be doubted too, whether ſome of theſe Trees thus liable to the Fury of the Froſt, have not been *Caltie*; a Term commonly uſed among *Timber-Merchants*, and by them avoided; which is, towards the Middle of the Tree, among the *Annual Circles*, ſome one is much larger than the reſt, and the *Sap-Veſſels* there ſeem much extended beyond their Fellows; and upon cleaving or ſawing ſuch a Tree, that incloſed or inward Heart, Part thereof where that Circle is, will ſlip and drop from the other Part oft-times without any Force to divide it, as an Inſtrument out of a Caſe or Mould made fit for it.

Some ſuppoſe that theſe *wind-ſhaken* or *lagg'd* Trees may be known, or nearly gueſſed at by the Out-ſide, when growing, by the great Ribs, two, three, or four in a Tree from the Bottom to the Branches, and that they have been affected ſomewhat conſiderably with this Diſeaſe before, and perhaps cleft, (tho' not in ſo great a Meaſure as now) and the Fiſſures cloſed up again; as we ſee theſe do quickly after the Froſt, inſomuch that it is ſcarce diſcernible already, and the Bark not having been divided from the Body, upon coming together again, each turn and twiſt of the Grain fitting its Place, prove freſh, and vigorouſly growing: But that ever ſuch Trees will prove whole and ſound, doth ſcarcely conſiſt with Reaſon or our preſent Thoughts. And this Calamity hath not been found in Trees only that were freſh and ſtanding, but alſo in Trees cut down, as is affirmed by Mr. *Sbiſh* and others; but notwithſtanding it is thought to be only among ſuch diſeaſed Trees as are before-mentioned.

But it is yet to be queſtioned whether *Vines* have proved cleft and crackt along the Bodies by the ſame Way and Reaſon as *Timber-Trees*, which Decay is eſpecially to be ſeen on Walls expoſed to the Southern Aſpect; ſo that the Sun, our accuſtomed Friend, now proved our great Enemy, by thawing and relaxing the Sap every Day, and then being frozen and made ſtiff again every Night; which often Repetition of bending and unbending, ſoftening and hardning, the vivid ſpirituous Juice being deſtroyed, and Day and Night the Drought vigorouſly acting (the Sap being this Year diſordered and ſurprized, not gradually ſeaſoned even before *Michaelmas-Day*, and the freſh Sap to ſupply its Defects being wholly detained from ariſing, there then being none, or very little Exhalations or Evaporations ariſing out of the frozen and bound Earth) theſe poor ſlender Bodies fill'd only with thin and not viſcous *Sap*, have proved as great Sufferers as if by Amputation they had been deprived of their natural Suſtenance; for if they could have none from the Earth, and their own true Juice mortified; and it be certain that *omne Siccum appetit humidum*, it will follow that ſuch Branches will by the Conſtancy and Continuance of ſuch Sevrity (the Day being as bad as the Night) prove as dry as Sticks cut off long before: whereas thoſe of this kind and other ſorts alſo growing in more ſhadowy Parts, and undergoing but one Change, have remained in good Condition, eſpecially among red Grapes, which ſeem much more hardy than white ones.

We ſee other *Wall-Fruits* on the ſame Poſition, as *Apricocks*, *Peaches*, *Plumbs*, *Cherries*, &c. are not at all injured or prejudiced by the Weather, which are of a more clammy viſcous Juice: Theſe we ſee run ſometimes and give *Gum*, but the Leakage of *Vines* is as thin as Water; which different *Juices* and *Saps* in other Trees, and the Degrees thereof, as well thoſe with deciduous Leaves, as *Ever-greens*, may prove ſome Cauſe of the Weakneſs and Decay of ſome, whilſt that of another ſort ſtanding by, remains freſh and vigorous, only ſtagnated, ſedate and quiet, waiting for the benign Sun's Beams to actuate, lenify, and put its Spirits in Motion, and its comfortable Refreſhment to ariſe in due Seaſon: And perhaps according to the Degree of this Qualification in Trees and Plants (ſome being much more ſluggiſh than other) may be the Cauſe of their earlier or later *Germination*.

It is eaſily obſerved, that in dry, mountainous, rocky and barren Plantations, where Trees, Greens, and other Plants having been ſparingly fed, and not pamper'd with ſuch Luxuriance and freeneſs of Sap, as in the Vallies and richer Soils, have eſcaped tolerably well: and this, which in other Years proves their Poverty and Diſeaſe, now makes them inſult over thoſe growing in the fatter Vallies, proportional to the Height of the Hills they grow on.

We may obſerve Trees all the Winter, while the *Sap* remains condenſed, to be ſafe and well, but if a flattering too early Glance happens in the Spring to ſet their Parts in Action, and the *Juices* to become fluid, and a ſudden Mutation of that Warmth to a freſh return of Winter (which too frequently happens in *England*) that then we have not only our Hopes of that Year's Fruit blaſted, but even the Paſſages in the Branches and Boughs ſtopped, and the crude *Sap* ſettling, commonly called *Bliting* (though there be many Cauſes of the Effects which go under that Notion) becomes a Diſeaſe in Trees equal to that of *Chil-blanes* in juvenile Blood, which ſometimes takes whole Trees, and ſometimes Branches only. Hence is ſuppoſed the Decay of the *Glaſtenbury Thorn*, whoſe Ariſing-time being between *Michaelmas* and

Chriſtmas, being ſappily prepared by the Beginning of the hard *Froſt*, which hath almoſt affrighted it out of its Life.

Some Trees and Shrubs ſeem to have their Veſſels and Paſſages ſo ſtreightned, and as it were ſhrunk with *Cold*, that they appear equal to a human Body *Sinew-ſhrunk* or *Paralytick*, that is, not without much Trouble able to move or bear his decaying Limbs: Thus we ſee *Trees* with their Bark ſhrivel'd, with their Paſſages half-ſtopp'd, whoſe *Sap* now only ſqueezing, and difficultly paſſing, hath much ado to force its Way through the dry'd and narrow Pores and Paſſages of the Body and Branches: And ſometimes this Diſtemper is ſo prevalent, that whole Branches of a Tree are killed, when the other Part is indifferent well.

Some Liquids, ſuch as *Eſſential Oils*, do rather ſhrink than increaſe being frozen; and *Empyreumatical Oils*, will hardly freeze but waſte; which Conſiderations may induce the Thoughts of what ſome *Trees* are made of, or do abound in, as *Firs*, *Pines*, &c. which are capable of enduring the *Cold* of *Norway*, and other Countries.

What *Timber-Trees* have ſuffered, are above ſpecified; but divers others of our native *Trees* and *Shrubs* have ſcarcely proved able to withſtand the Force of ſo rude an Enemy. *Yew* and *Holly* (Things whoſe Tenderneſs was never ſuſpected) were in ſome places quite kill'd, and in many Places ſo diſcourag'd, loſing their Leaves, and blemiſhing the Bark, that it is to be feared they will never take on their priſtine Splendor and Verdure; the *Furze* in many Places quite kill'd, and in moſt Places cut down and ſpring again, but often the Reſurrection in vain expected. Common *Broom* proves a Degree hardier. In ſome Places the ſunny Side of a *Juniper Buſh* proves ſcorch'd between Sun and Cold, but that proves one of the moſt hardy of our native *Greens*; ſo that it is hard to ſay what is Winter-proof even among our Natives, except *Box* and *Ivy*, which ſtand in Defiance of all.

In the Gardens (which are generally Nurſeries of *Exoticks*, and from warm Countries) this Calamity hath principally bent its Force againſt *Winter Greens*, ſuch as *Alaternus* (commonly known by the Name of *Phillyrea*) and the true *Phillyrea* alſo, which are generally kill'd; though ſome upon cutting down ſpring again. Alſo common *Bays* ſeem in moſt Places to be kill'd down, and *Laurel* ſeldom proving impatient, is in ſome Places kill'd, in ſome Places half dead; *Roſemary*, *Lauruſtine*, *Halimus*, *Arbutus*, white *Jeſſamine*, and other which ſeldom fail, are generally kill'd through the whole Country. But in all theſe, and other ſuch like, in mountainous and dry Places (as was before obſerved) there is briſk Life and Verdure yet remaining, tho' rarely to be met with; but however, enough to retain the ſeveral *Species* among us. But if for the future in ſuch Times of Extremity, the Superficies of the Ground, and Bodies of ſuch Things here recited, and *Fig-trees*, were well covered with ſtrawy Matter to keep off the Froſt, it might ſo preſerve them as to ſpring out plentifully the Spring following, tho' their whole Tops being too large and high, and thereby incapable of ſuch Covering, might loſe their preſent Leaves and Beauty; which might from ſuch Reſpringing be eaſily repaired, and prove much more ſatisfactory than to begin the World anew, as we are generally forc'd to do for *Cypreſſes*, which were us'd to be excellent Ornaments both in Summer and Winter, now it proving a very rare Thing to ſee one well alive; in ſome Places there appears ſome lingring Life, though ſcarcely ſufficient to recover the whole; but in moſt Places they are quite dead, that have faced forty, fifty, or ſixty Winters before.

Alſo among thoſe with *Deciduous Leaves*, divers have been Sufferers, as *Arbor Judæ*, young *Plane Trees*; though thoſe of a conſiderable Stature have pretty well eſcaped; *Paliurus*, the *Aleppo Aſh*; in ſome Places the *Locuſt Tree*; and in moſt Hedges the great common Bramble, and ſome other, which upon cutting do ſome or moſt of them ſpring again.

But ſuch *Greens* alſo as we receive from abroad, and are the Glory of warmer Countries, and very rare, curious and pleaſant with us, ſuch as *Oranges*, *Lemons*, *Myrtles*, *Pomegranates*, and the perfuming *Jaſmines*, and divers other Rarities, which are uſually kept in Pots and Caſes, for the Convenience of removing them into *Green Houſes* and *Conſervatories*, not being able to endure our milder Winters, have in many Places extremely ſuffered, eſpecially in Houſes of weaker Defence: But where the Skill, Care, and due Management of their Keepers, have met with the Convenience of good warm Houſes, with keeping conſtant Fires (which is a Matter to be regulated with great Diſcretion) according to the Proportion of which combining Qualifications the Plants have eſcaped; as in ſome Places moſt of them are well, and in ſome Places half, and in ſome Places all dead.

Among *Plants*, *Herbs*, and *Flowers*, there hath been great Deſtruction alſo, and many of common Uſe, as moſt of the *Artichokes* in *England*, and *Winter Coleflowers*, *Sage*, *Thyme*, *Maſtick*, *Lavender*, *Lavender-Cotton*, and divers other were generally kill'd; except ſuch as happened to be new planted that Year, and ſo low, that they had the Enjoyment of the kind covering of a little *Snow*, which proves the moſt natural Feeding and warm Covering of any Thing to be mention'd; but what peeped its Head above it, ſeemed in great Danger of being kill'd; and as we may ſee in the *Corn-fields*, that thoſe Sides of the Lands of Corn facing the South, where the Snow was melted, and the Corn deprived of its Covering, the Want proved deadly, and in many Places Huſbandmen were forced to begin again in the Spring to plough and ſow other Grain; which may eaſily teach us rather to heap *Snow* upon our Herbs and Flowers, than fancy it a cold, unkind Enemy.

But after all this Repetition of Sorrows we are to comfort our ſelves that ſuch Deſtruction and Calamity happens but very rarely, the like having not been known in the Memory of Man, if ever before, and that with due Care and Obſervance the growing Cold might be kept off from ſuch Things as are proved to be impatient of it; which are not all *Greens* in our Gardens; ſome being able to endure all the Cold that ever came; as *Firs*, *Pines* of divers ſorts, *Cedars* of *Libanus* and *Virginia* (tho' that of *Bermudas* proves tender) *Arbor Vitæ*, all the *Savins*, whereof the upright or *Berry-bearing* is the beſt *Succedaneum* to *Cypreſs*, capable of finer cutting into *Pyramids*, or other Figures, or Hedges 6 or 8 Foot high, and is one of the beſt of the *Tonſile Shrubs*; alſo the *Pyracantha* proves exceeding hardy, and makes good Hedges.

LIV.

To preſerve Ice and Snow; by Mr. W. Ball, n. 8. p. 139.

LIV. The *Snow* and *Ice-houſes* at *Livorne*, are commonly built on the ſide of a ſteep Hill, being only a deep Hole in the Ground, by which Means they eaſily make a Paſſage out from the Bottom of it, to carry away all the Water; which if it ſhould remain ſtagnating therein, would melt the *Ice* and *Snow*: But they thatch it with Straw, in the Shape of a Sauce-pan Cover, that the Rain may not come at it. The Sides (ſuppoſing it dry) they line not with any Thing, as is done in St. *James*'s Park, by Reaſon of the Moiſtneſs of the Ground. This Pit they fill full of *Snow* or *Ice* (taking Care that the *Ice* be made of the pureſt Water, becauſe they put it into their Wine) overſpreading firſt the Bottom very well with *Chaff*, but without any Part of the Straw; I think they uſe *Barley-chaff*. This done, they further, as they put in the *Ice* or the *Snow* (which latter they ram down) line it thick by the Sides with ſuch *Chaff*, and afterwards cover it well with the ſame; and in half a Year lying ſo, 'tis found not to want above an eighth Part of what it weighed when firſt put in. Whenever they take it out into the Air, they wrap it up in this Chaff, and it keeps it to Admiration.

Cold produced with Sal Armoniac, *by Mr.* R. Boyle n. 15. p. 255.

LV. Among ſeveral Ways by which I have made *infrigidating* Mixtures with *Sal Armoniac*, the moſt ſimple and facile is this: Take one Pound of powder'd *Sal Armoniac*, and about three Pints (or Pounds) of Water, put the *Salt* into the Liquor, either all together, if your Deſign be to produce an intenſe, though but a ſhort, *Coldneſs*; or at two, three, or four ſeveral Times, if you deſire that the produced *Coldneſs* ſhould rather laſt ſomewhat longer than be ſo great: Stir the Powder in the Liquor with a Stick or a Whalebone (or ſome other Thing that will not be injured by the fretting Brine that will be made) to haſten the Diſſolution of the *Salt*; upon the Quickneſs of which depends very much the Intenſity of the *Cold* that will enſue upon this Experiment.

That a conſiderable Degree of *Cold* is really produced by this Operation, is very evident: *Firſt*, to the Touch. *Secondly*, By this, that if you make the Experiment (as for this Reaſon I ſometimes chooſe to do) in a Glaſs Body, or a Tankard, you may obſerve, that whilſt the Solution of the *Salt* is making, the Outſide of the metalline Veſſel will, as high as the Mixture reaches within, be bedewed (if I may ſo ſpeak) with a Multitude of little Drops of Water; as it happens when Mixtures of *Snow* and *Salt*, being put into Glaſſes or other Veſſels, the aqueous Vapours that ſwim to and fro in the Air, and chance to glide along the ſides of the Veſſels, are by the Coldneſs thereof condenſed into Water. But, *Thirdly*, The beſt and ſureſt Way of finding out the *Coldneſs* of our Mixture, is by plunging into it a good ſeal'd *Weather-glaſs* furniſh'd with tinged Spirit of Wine. For, the Ball of this being put into our *frigorifick* Mixture, the crimſon Liquor will nimbly enough deſcend much lower, than when it was kept either in the open Air, or in common Water, of the ſame Temper with that wherein the *Sal Armoniac* was put to diſſolve. And if you remove the Glaſs out of our Mixture into common Water, the tinged Spirit will re-aſcend; and this has alſo ſucceeded with

with me when I removed it into Water newly impregnated with *Salt Petre.*

This *Cold* in Summer and hot Weather will ſoon decay and expire: But if the Quantity of the *Salt* and *Water* be great, the Effect will be as well more laſting as more conſiderable. I have Reaſon too to ſuſpect, that there may be a conſiderable diſparity, as to their Fitneſs to produce *Cold*, betwixt ſeveral Parcels of *Salt* that are without Scruple look'd upon as *Sal Armoniac.* I have alſo often found, that when the tinged Liquor ſubſided but ſlowly, or was at a Stand, by putting in from Time to Time two or three Spoonfuls of freſh *Salt*, and ſtirring the Water to quicken the Diſſolution, the *Spirit* of *Wine* would begin again to deſcend, if it were at a Stand or Riſing, or ſubſide much more ſwiftly than it did before. And if you would lengthen the Experiment, it may not be amiſs that Part of the *Sal Armoniac* be but groſly beaten, that it may be the longer in diſſolving, and conſequently in cooling the Water. After this Manner a ſenſible, adventitious *Cold* has been made in the Spring, by a Pound of *Sal Armoniac*, at the utmoſt, to laſt about two or three Hours.

Experiments in *March*, 27. The tinged Spirit in the ſealed *Weather-Glaſs*, when firſt put into the Water, reſted $8\frac{1}{8}$ Inches. Being ſuffered to ſtay there a good while, and now and then ſtirr'd to and fro in the Water, it deſcended at length a little beneath $7\frac{1}{8}$ Inches. Then the *Sal Armoniac* being put in, within about a Quarter of an Hour, or a little more, it deſcended to $2\frac{11}{16}$ Inches; but before that Time in half a Quarter of an Hour, it began manifeſtly to freeze the Vapours and Drops of Water on the Outſide of the Glaſs. And when the *frigorifick* Power was arrived at the Height, I ſeveral Times found that Water thinly placed on the Out-ſide, whilſt the Mixture within was nimbly ſtirr'd up and down, would freeze in a Quarter of a Minute, by a Minute Watch. At about $\frac{1}{4}$ of an Hour after the *infrigidating* Body was put in the *Thermoſcope*, that had been taken out a while before, and yet was riſen but to the loweſt freezing Mark, being again put in, the Liquor fell an Inch beneath the Mark. And about $2\frac{1}{2}$ Hours from the firſt Solution of the *Salt*, I found the tinged Liquor to be in the midſt between the freezing Marks, whereof the one was at $5\frac{1}{2}$ Inches (at which Height, when the Tincture reſted, it would uſually be ſome, though but a ſmall, *Froſt* abroad) and the other at $4\frac{1}{4}$ Inches; which was the Height to which ſtrong and durable *Froſt* had reduced the Liquor in the Winter. At three Hours after the Beginning of the Obſervation, I found not the crimſon Liquor higher than the upper freezing Mark newly mentioned; after which it continued to riſe very ſlowly for about an Hour longer; beyond which Time I had not Occaſion to obſerve it.

2. This *frigorifick* Mixture having been made in a Glaſs-Body (as they call it) with a large and flattiſh Bottom, a Quantity of Water, which I (purpoſely) ſpilt upon the Table, was by the Operation of the Mixture within the Glaſs, made to freeze, and that ſtrongly enough, the Bottom of the Cucurbite to the Table; that ſtagnant Liquor being turned into ſolid Ice, that continued a conſiderable while unthaw'd away, and was in ſome Places about the Thickneſs of a half Crown piece.

3. At another Time in the ſame Spring, the *Weather-Glaſs*, which before it touched the common Water, ſtood at $8\frac{1}{8}$, having been left there a conſiderable while, and once or twice agitated in the Water, the tinged Liquor ſunk but to $7\frac{2}{8}$; or at fartheſt, to $7\frac{4}{8}$; then the *frigorifick* Liquor being put into the Water, with Circumſtances diſadvantageous enough, in (about) half a Quarter of an Hour the tinged Liquor fell beneath $3\frac{1}{4}$, and the *Thermoſcope* being taken out, and then put in again, an Hour after the Water had been firſt *infrigidated*, ſubſided beneath five Inches, and conſequently within $\frac{1}{4}$ of an Inch of a Mark of the ſtrongly freezing Weather.

The grand Thing that is like to keep this Experiment from being generally uſeful, is the Dearneſs of *Sal Armoniac*. But to leſſen this Inconvenience, two Things may be offer'd; *Firſt*, That *Sal Armoniac* might be made much cheaper, if inſtead of fetching it beyond Sea, our Country men made it here at home. *Secondly*, That though an *Armoniac* Solution being boil'd up in Earthen Veſſels (for Glaſs ones are too chargeable) will, by piercing them, both loſe ſome of the more ſubtile Parts, and thereby ſomewhat impair the Texture of the reſt; yet I was not deceived in expecting, that the dry Salt, remaining in the Pipkins, being re-diſſolved in a due Proportion of Water, would very conſiderably infrigidate it; as may farther appear by the following Experiment.

4. *March* 29. The *Thermoſcope* in the *Air* was at $8\frac{2}{8}$ Inches; being put into a ſomewhat large evaporating Glaſs, fill'd with Water, it fell after it ſtay'd a pretty while, and had been agitated in the Liquor, to eight Inches: Then about half the Salt, or leſs, that had been uſed twice before, and felt much leſs cold than the Water, being put in and ſtirr'd about, the tinged Spirit ſubſided with a viſible Progreſs, till it had fallen manifeſtly beneath four Inches; and then having cauſed ſome Water to be freſhly pump'd and brought in, though the newly-mentioned Solution were mix'd with it, yet it preſently made the Spirit of Wine manifeſtly to aſcend in the Inſtrument, much faſter than one would have expected.

The Length of the Cylindrical Pipe of the ſeal'd *Thermoſcope*, wherewith theſe Obſervations were made, was ſixteen Inches; the Ball about the Bigneſs of a ſomewhat large Walnut, and the Cavity of the Pipe, by Gueſs, about an eighth or ninth Part of an Inch Diameter.

To cool Drinks, with this Mixture, you may put them in thin Glaſſes, the thinner the better; which (their Orifices being ſtopp'd, and ſtill kept above the Mixture) may be moved to and fro in it; and then be immediately poured out to be drunk. By the Help hereof, Pieces of Cryſtal, or Bullets, for the cooling of the Mouth or Hands of thoſe Patients, to whom it may be allowed, may be potently cooled; and other ſuch Refreſhments may be eaſily procured. In which, and many other Uſes, it will not be requiſite to employ near ſo much as a whole Pound of *Sal Armoniac* at a Time. For, you may eaſily obſerve, by a ſeal'd *Weather-Glaſs*, that a very few Ounces, well powder'd and nimbly diſſolv'd in about four Times the Weight of Water, will ſerve well enough for many Purpoſes.

Experiments about Freezing; by S. Carolo Rinaldini, n. 72. p. 2169.

LVI. 1. A little Water being left at the Top of the *Mercury* in the *Torricellian* Experiment, and expoſed to the Air in Froſty Weather, was in one Night congealed into *Ice* of a very good Conſiſtence. Afterwards, *Rinaldini* having compared this *Ice* with that which was produced in the open Air, found, that the *Ice* in the Cane was in Subſtance altogether like that of *Hail*; that is, an opake and whitiſh Body: Whereas that which was made in the Air was tranſparent like Cryſtal. Beſides, he obſerved that the *Ice* made in the Cane was heavier *in Specie* than that in the ambient Air, which he diſcover'd by putting it into a Fluid, which was *in Specie* lighter than Water, but heavier than *Ice* made in the open Air; whereby he found, that whereas the *Ice* made in the Cane ſunk, that in the Air floated therein.

By Dr. Liſter, n. 167. p. 835.

2. *December* 3, 1684. At Night I expoſed four Glaſs Bottles in the open Air upon the Ground to freeze; *viz.* of the *Red Natron-Water* from *Egypt*; of a ſtrong Solution of *Nitrum Murarium* in fair Water, of *Sea-Water* taken up at *Scarborough*, and more than half evaporated; of the *Sulphur Well* at *Knaſborough*, that is, of *Natural Brine* evaporated to the ſame Height with the *Sea-Water*.

The fourth in the Morning, the Solution of *Nitrum Murarium* was half of it *Ice*, but not any of the reſt.

The ſixth in the Morning, the Bottle of *Nitrum Murarium* was moſt *Ice*; the *Sulphur-Water* had no *Ice* that I could perceive at all in it; the *Natron* had much *Ice* at the Bottom of the Bottle; and the *Scarborough Sea-Water* was not without Flakes of *Ice*.

Fig. 21, 22.

The *Icicles* of the *Natron* were prettily figured, as is repreſented in *Fig.* 21. The *Icicles* of the *Sea-Water* were alſo figured in oblong Squares, as in *Fig.* 22. and were brittle and tranſparent. I ſet the drained *Icicles* of *Natron* before the Fire, which did readily enough melt and diſſolve into Water again; this *Ice* was both alike ſalt in *Ice* and in *Water*, much like the Water, to the Taſte, out of which it was frozen. In like Manner having drained the *Sea-Water Ice*, and expos'd it before the Fire, theſe *Icicles* became ſoft and moiſt by Degrees, but at length rather evaporated than quite melted away; and having taken up a good thick Lump of common *Ice*, at leaſt an hundred Times their Thickneſs and Bulk, this in a few Moments at the ſame Diſtance before the Fire, grew wetter and wetter, and diſſolved into Water; whereas the *Salt Icicles*, after three Quarters of an Hour lying before the Fire, did at length dry into a white Powder perfect Salt, the moiſture totally evaporating. Alſo the *Sea-Water Icicles* taſted very ſalt, when firſt taken out of the Water.

I repeated the ſame Experiment of expoſing to freeze the Bottles of *Natural Brine* of *Knaſbborough Sulphur-Well*, half evaporated, and *Scarborough Sea-Water*, the ſame as formerly, the ſeven and eighth Inſtant at Night, and with the like Succeſs, *viz.* no *Icicles* in the *Natural Brine*; but the ſame large ones as above deſcribed I had in the *Sea-Water*, but not till after the ſecond Night's keen Freezing.

Theſe *ſalt Icicles* continued unthawed in the Bottles, though they were brought into the Houſe, and kept in a warm Room, long after all other *Ice*

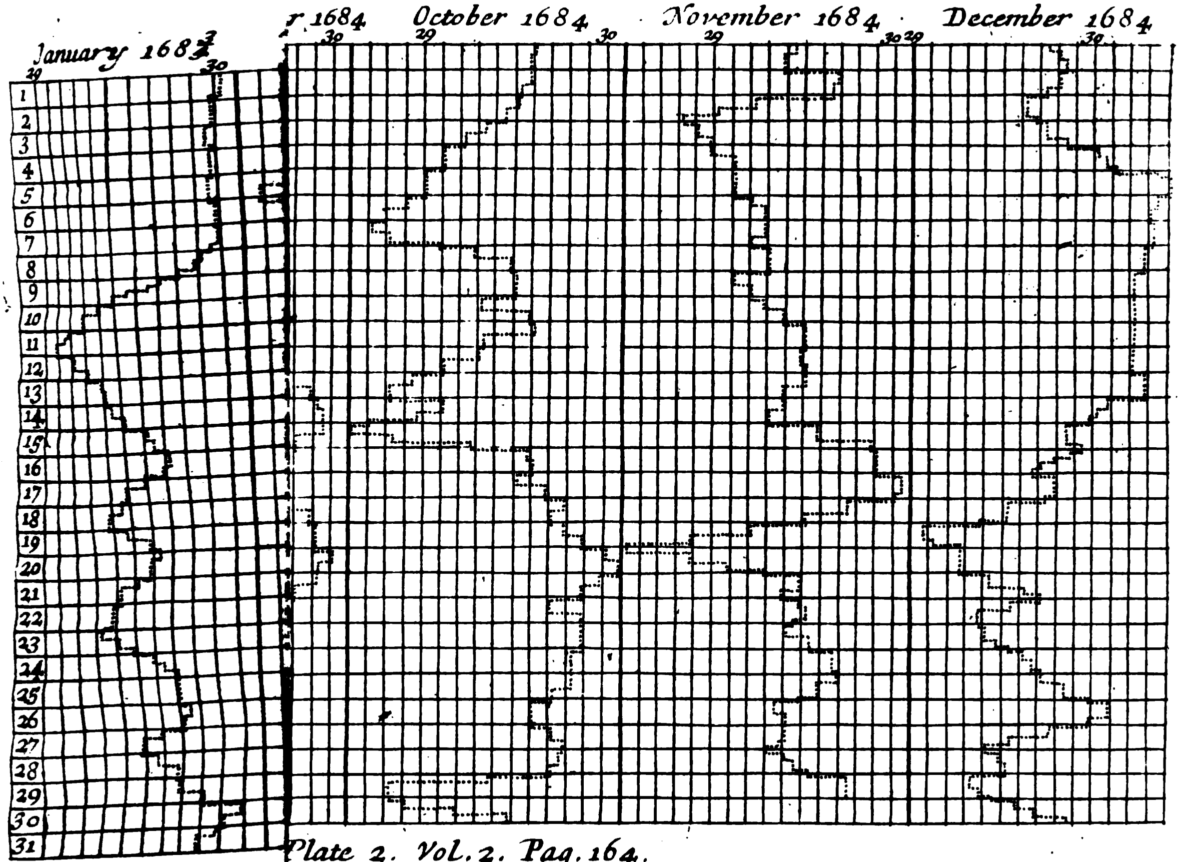


Plate 2. Vol. 2. Pag. 164.

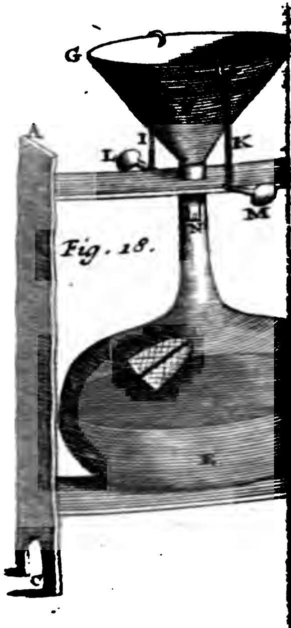
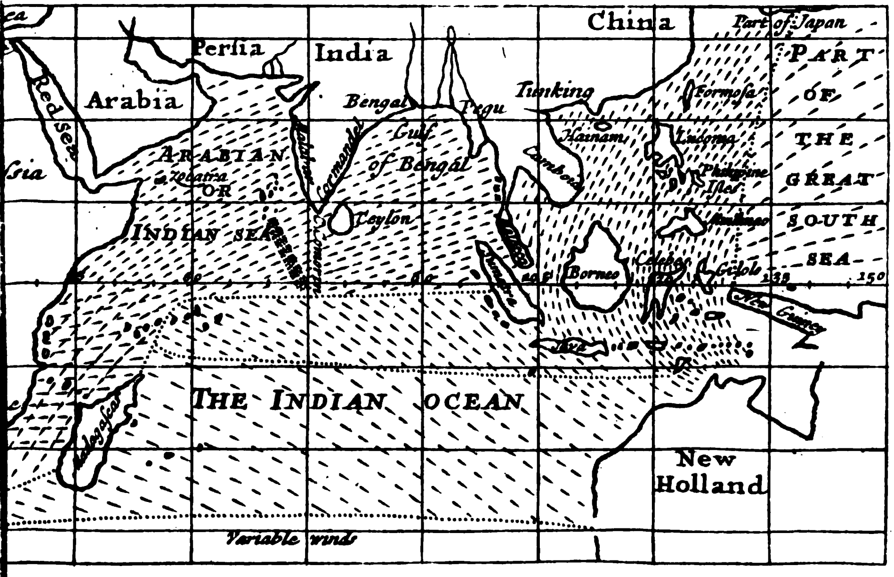


Fig. 18.



within Doors was gone, *viz.* till the twelfth Inſtant at Night, when the *Icicles* alſo were diſſolved and vaniſh'd.

From theſe Experiments we note, 1. That there may be *Salt-Ice* from *Sea-Water frozen*, which the Experiments of this *S.* of the laſt Year did not ſeem to favour.

2. That there is as real Difference betwixt *Natural Brine* and *Sea-Water*, as there is betwixt the Salts themſelves which they yield.

3. That the great floating Mountains of Ice in the *Northern Seas* (if upon ſtrict Trial they ſhall be found to be Salt, which ſhould be further enquired into) are not only the Effects of many Years Freezing, but alſo much of their Magnitude may be owing to the natural Duration of that Sort of *Ice.*

4. A Tube of $\frac{1}{4}$ of an Inch Diameter, being fill'd with Water, to the Height of two Inches, and ſet to *freeze* in a Mixture of Snow and Salt, the Water, when perfectly frozen, appeared $\frac{1}{16}$ of an Inch above the Mark it ſtood at before freezing. *By M.* Des Maſters, n. 245. p. 384. n. 247. p. 439.

Another Tube, of almoſt an Inch Diameter, being filled with Water to the Height of ſix Inches, and ſet to freeze as before, roſe $\frac{2}{8}$ of an Inch above the Mark. The Water made Uſe of in theſe Trials, was a Sort of rough *Pump-Water*; which, according to what Trials have been made with it, does, upon the Effuſion of *Oil* of *Tartar per Deliquium*, immediately turn milky and turbid. And the Ice made of this Water, was a Sort of very rarified white *Ice.*

The Tube of almoſt an Inch Diameter being fill'd to the Height of ſix Inches (as before) with *River-Water*, which would readily mix with *Oil* of *Tartar* without the leaſt Precipitation, and ſet to freeze in a Mixture of Snow and Salt, it gained but $\frac{1}{8}$ of an Inch after it was frozen; whereas the *Pump-Water* got $\frac{2}{8}$ of an Inch.

It was obſervable, that when the *Water* (in all theſe Experiments) began to freeze, a great many ſmall Bubbles continually roſe from the Bottom.

A Tube being fill'd with *boiled Pump-Water*, to the Height of ſix Inches, and ſet to freeze as before, it roſe hardly to $\frac{1}{8}$ of an Inch above the Mark, when as the ſame Water *unboiled* roſe to $\frac{2}{8}$.

LVII. In *July*, 1653. It was ſo furiouſly hot in *Poland*, that in the Regiment of Foot which was the King's Guard, marching moſt of them Bare-foot upon Sands, more than 100 fell down altogether diſabled, whereof a Dozen died outright, without any other Sickneſs. *Exceſſive* Heats *in* Poland; *by M.* Febre, n. 19. p. 352.

LVIII. If the Action of the *Sun* be conſidered as the only Cauſe of the *Heat* of the *Weather*, I ſee no Reaſon but that under the *Pole*, the Solſtitial Day ought to be as hot as it is under the *Equinoctial*, when the Sun comes vertical, or over the *Zenith*; for this Reaſon, that for all the 24 Hours of the Day under the *Pole*, the *Sun*'s Beams are inclined to the Horizon, with an Angle of $23\frac{1}{2}$ *Deg.* and under the *Equinoctial*, though he come vertical, yet he ſhines no more than 12 Hours, and is again 12 Hours abſent; and that *The Proportional* Heat *of the* Sun *in all* Latitudes; *by Mr.* Edm. Halley, n. 23. p. 878.

for 3 Hours 8 Minutes of that 12 Hours he is not ſo much elevated as under the *Pole*; ſo that he is not 9 of the whole 24 higher than 'tis there, and is 15 Hours lower. Now the ſimple Action of the *Sun* is, as all other Impulſes or Strokes, more or leſs forcible, according to the *Sines* of the *Angle* of *Incidence*, or to the Perpendicular let fall on the Plane; whence the *vertical* Ray (being that of the greateſt *Heat*) being put *Radius*, the Force of the *Sun* on the horizontal Surface of the Earth will be to that, as the *Sines* of the *Sun*'s Altitude at any other Time. This being allow'd for true, it will then follow, that the Time of the Continuance of the *Sun*'s Shining being taken for a *Baſis*, and the *Sines* of the Sun's Altitudes erected thereon as Perpendiculars, and a Curve drawn through the Extremities of thoſe Perpendiculars, the Area comprehended ſhall be proportionate to the Collection of the *Heat* of all the Beams of the *Sun* in that Space of Time. Hence it will follow, that under the *Pole* the Collection of all the *Heat* of a *Tropical* Day, is proportionate to a *Rectangle* of the *Sine* of 23½ *Gr.* into 24 Hours, or the Circumference of a Circle; that is, the *Sine* of 23½ *Gr.* being nearly $\frac{4}{10}$ of *Radius*, as $\frac{8}{10}$ into 12 Hours. Or the *Polar Heat* is equal to that of the *Sun* continuing 12 Hours above the Horizon, at 53 *Gr.* Height, than which the *Sun* is not 5 Hours more elevated under the *Equinoctial*.

Fig. 23 But that this Matter may be the better underſtood, I have exemplified it by a Scheme, wherein the *Area Z G H H*, is equal to the *Area* of all the *Sines* of the *Sun*'s Altitude under the *Equinoctial* erected on the reſpective Hours, from *Sun-riſe* to the *Zenith*, and the *Area* ♋ *H H* ♋ is in the ſame Proportion to the Heat for the ſame ſix Hours under the *Pole* on the *Tropical* Day, and ☉ *H H* ♌, is proportional to the collected Heat, of twelve Hours, or half a Day, under the *Pole*; which Space ☉ *H H* ♌, is viſibly greater than the other *Area H Z G H*, by as much as the *Area H G* ♌ is greater than the *Area Z G* ☉; which, that it is ſo, is viſible to Sight, by the great Exceſs; and ſo much in Proportion does the Heat of the twenty four Hours *Sun-ſhine* under the *Pole*, exceed that of the twelve Hours under the *Equinoctial*: Whence, *cæteris paribus*, it is reaſonable to conclude, that were the *Sun* perpetually under the *Tropick*, the *Pole* would be at leaſt as warm as it is now under the *Line* it ſelf.

But whereas the Nature of *Heat* is, to remain in the Subject after the Cauſe that heated is removed, and particularly in the Air, under the *Equinoctial*; the 12 Hours Abſence of the *Sun* does very little ſtill the Motion impreſs'd by the paſt Action of his Rays wherein *Heat* conſiſts, before he ariſe again: But under the *Pole*, the long abſence of the *Sun* for ſix Months, wherein the Extremity of *Cold* does obtain, has ſo chill'd the Air, that it is as it were frozen, and cannot before the *Sun* has got far towards it, be any way ſenſible of its Preſence; his Beams being obſtructed by the thick Clouds, and perpetual Foggs and Miſts, and by that *Atmoſphere* of *Cold*, as the late Honourable Mr. *Boyle* was pleaſed to term it, proceeding from the everlaſting *Ice*, which in immenſe Quantities does chill the neighbouring Air, and which the too ſoon Retreat of the *Sun* leaves *unthawed*, to increaſe again during the long Winter that follows this ſhort interval of Summer.

But the differing Degrees of *Heat* and *Cold* in differing Places, depend in a great Meaſure upon the Accidents of the Neighbourhood of high Mountains, whoſe Height exceedingly chills the Air brought by the Winds over them; and of the Nature of the Soil, which variouſly retains the *Heat*, and particularly the Sandy, which in *Africa*, *Arabia*, and generally where ſuch *ſandy Deſarts* are found, do make the *Heat* of the Summer incredible to thoſe that have not felt it.

In Proſecution of this Thought, I have ſolved this *Problem* generally, *viz. To give the proportional Degree of Heat, or the Sum of all the Sines of the Sun's Altitude, while he is above the Horizon in any oblique Sphere*, by reducing it to the finding of the Curve Surface of a *Cylindrick Hoof*; or of a given Part thereof.

Now this *Problem* is not of that Difficulty as appears at firſt ſight; for let *Fig.* 24. the *Cylinder A B C D* be cut obliquely, with the *Ellipſe B K D I*; and by the Center thereof *H*, deſcribe the Circle *I K L M*; I ſay the Curve Surface *I K L B*, is equal to the Rectangle of *I K* and *B L*, or of *H K* and 2 *B L*, or *B C*: And if there be ſuppoſed another Circle, as *N O P Q*, cutting the ſaid *Ellipſe* in the Points *P*, *Q*; draw *P S*, *Q R*, parallel to the Cylinder's Axe, till they meet with the aforeſaid Circle *I K L M*, in the Points *R S*; and draw the Lines *R T S*, *Q V P*, biſected in *T* and *V*. I ſay again, That the Curve Surface *R M S Q D P*, is equal to the Rectangle of *B L*, or *M D*, and *R S*, or of 2 *B L*, or *A D*, and *S T*, or *V P*; and the Curve Surface *Q N P D*, is equal to *R S* × *M D*— the Arch *R M S* × *S P*, or the Arch *M S* × 2 *S P*: or, it is equal to the Surface *R M S Q D P*, ſubtracting the Surface *R M S Q N P*. So likewiſe the Curve Surface *Q B P O* is equal to the Sum of the Surface *R M S Q D P*, or *R S* × *M D*, and of the Surface *R L S Q O P*, or the Arch *L S* × 2 *S P*.

This is moſt eaſily demonſtrated from the Conſideration, That the *Cylindrick* Surface *I K L B* is to the inſcribed *Spherical* Surface *I K L E*, either in the Whole, or in its analogous Parts, as the Tangent *B L* is to the Arch *E L*; and from the Demonſtrations of *Archimedes, de Sphæra & Cylindro, Lib.* 1. *Prop.* 30, 37, and 38; and Doctor *Barrow*'s learned *Lectures* on that Book, *Prob.* 9. and the Corollaries thereof.

Now to reduce our Caſe of the Sum of all the *Sines* of the Sun's Altitude *Fig.* 25. in a given Declination and Latitude to the aforeſaid *Problem*, let us conſider the *Analemma* projected on the Plan of the Meridian; *Z*, the *Zenith*; P, the *Pole*; *H H*, the *Horizon*; *æ æ*, the *Equinoctial*; ♋ ♋ ♑ ♑, the two *Tropicks*; ♋ *I*, the Sine of the Meridian Altitude in ♋; and equal thereto, but perpendicular to the *Tropick*, erect ♋ 1, and Draw the Line *T* 1. interſecting the *Horizon* in *T*, and the Hour Circle of 6 in the Point 4, and 6, 4 ſhall be equal to 6 R, or to the Sine of the Altitude at 6: And the like for any other Point in the *Tropick*, erecting a Perpendicular thereat, terminated by the Line *Ti*. Through the Point 4, draw the Line 4 5 7, parallel to the *Tropick*, and repreſenting a Circle equal thereto; then ſhall the *Tropick* ♋ ♋ in *Fig.* 25. anſwer to the Circle *N O P Q*, in *Fig.* 24. The Circle 4 5 7 ſhall anſwer to the Circle *I K L M*; *T* 4 *i* ſhall anſwer to the *Elliptick* Segment *Q I B K P*; 6 *R*, or 6 4 ſhall anſwer to *S P*, and 5 1 to *B L*, and the Arch ♋ *T* to the Arch

L S, being the Semidiurnal Arch in that Latitude and Declination; the Sine whereof, though not expreſſible in *Fig.* 25. muſt be conceived as analogous to the Line *T S*, or *V P* in *Fig.* 24.

The Relation between theſe two Figures being well underſtood, it will follow from what preceeds, That the Sum of the Sines of the Meridian Altitudes of the Sun in the two *Tropicks* (and the like for any two oppoſite Parallels) being multiplied by the Sine of the Semidiurnal Arch, will give an Area analogous to the Curve Surface *R M S Q D P*; and thereto adding in Summer, or ſubtracting in Winter, the Product of the Length of the Semidiurnal Arch (taking according to *Van Ceulen*'s Numbers) into the Difference of the above-ſaid Sines of the Meridian Altitude; the Sum in one Caſe, and Difference in the other, ſhall be as the Aggregate of all the *Sines* of the Sun's Altitude during his Appearance above the *Horizon*; and conſequently of all his *Heat* or Action on the Plane of the *Horizon* in the propoſed Day: And this may alſo be extended to the Parts of the ſame Day; for if the aforeſaid Sum of the *Sines* of the Meridian Altitudes be multiplied by half the Sum of the *Sines* of the Sun's horary Diſtance from Noon, when the Times are before and after Noon; or by half their Difference, when both are on the ſame Side of the Meridian; and thereto in Summer, and therefrom in Winter, be added or ſubtracted, the Product of half the Arch anſwerable to the propoſed Interval of Time, into the Difference of the *Sines* of Meridian Altitudes; the Sum in one Caſe, and Difference in the other, ſhall be proportional to all the Action of the Sun during that Space of Time.

I foreſee it will be objected, that I take the *Radius* of my Circle, on which I erect my Perpendiculars always the ſame, whereas the Parallels of *Declination* are unequal; but to this I anſwer, that our ſaid Circular *Baſes* ought not to be analogous to the Parallels, but to the Times of Revolution, which are equal in all of them.

It may perhaps be uſeful to give an Example of the Computation of this Rule, which may ſeem difficult to ſome. Let the *Solſtitial Heat*, in ♋ and ♑, be required at *London*, *Lat.* 51, 32.

38° —— 28′ *Co. Lat.*	*Diff. Aſcen.* —— 33° — 11′.
23 —— 30 *Decl.* ☉	*Arc. Semidi.* Æſtiv. 123 —— 11.
61 —— 58 *Sinus* = 0,828674	*Arc. Semidiur.* Hyb. 56 —— 49 *Sin.* 0,836923.
14 —— 58 *Sinus* = 0,258257	*Arc.* Æſtiv. *menſura.* 2,149955.
Summa 1,140931	*Arc.* Hyber. *menſura.* 0,991683.
Diff. 0,624417	

Then 1,140931 in 0,836923+0,624417 in 2,149955=2,29734.

And 1,140931 in 0,836929—0,624417 in 0;991638=0,33895.

So that 2,29734 will be as the *Tropical* Summer's Day's *Heat*, and 0,33895 as the *Action* of the *Sun* in the Day of the Winter *Solſtice*.

After this Manner I computed the following Table, for every tenth *Deg.* of *Latitude* to the *Æquinoctial* and *Tropical* Sun; by which an Eſtimate may be made of the intermediate *Degrees*.

Lat.	*Sun in* ♈ ♎	*Sun in* ♋	*Sun in* ♑
0	20000	18341	18341
10	19696	20290	15834
20	18794	21737	13166
30	17321	22651	10124
40	15321	23048	6944
50	12855	22991	3798
60	10000	22773	1075
70	6840	23543	000
80	3473	24673	000
90	0000	25055	000

Vid. D. Wallis, de Calculo Centri Gravitatis, *Prop.* 13. *Cap.* 5.

From this Rule there follow ſeveral *Corollaries* worth Note: As, 1. That the *Equinoctial Heat*, when the Sun comes vertical, is as twice the Square of *Radius*; which may be propoſed as a Standard to compare with in all other Caſes. 2. That under the *Equinoctial*, the Heat is as the Sine of the Sun's Declination. 3. That in the *Frigid Zones*, when the Sun ſets not, the *Heat* is as the Circumference of a Circle into the Sine of the Altitude at 6. And conſequently, that in the ſame *Latitude* theſe Aggregates of *Warmth* are as the *Sines* of the Sun's Declinations; and in the ſame Declination of the Sun, they are as the *Sines* of the *Latitudes*; and generally they are as the *Sines* of the *Latitudes* into the *Sines* of Declination. 4. That the *Equinoctial* Day's *Heat* is every where as the *Co-ſine* of the *Latitude*. 5. In all Places where the Sun ſets, the Difference between the Summer and Winter *Heats*, when the Declinations are contrary, is equal to a Circle into the *Sine* of the Altitude at 6, in the Summer Parallel; and conſequently thoſe Differences are as the *Sines* of *Latitude* into or multiplied by the *Sines* of Declination. 6. From the Table I have added, it appears, that the *Tropical* Sun under the *Equinoctial* has, of all others the leaſt force: And under the *Pole* it is greater than any other Days *Heat* whatſoever, being to that of the *Equinoctial*, as 5 to 4.

From the Table and theſe *Corollaries* may a general Idea be conceived of the Sum of all the Actions of the *Sun* in the whole Year, and that Part of the *Heat* that ariſes ſimply from the Preſence of the *Sun*, be brought to a *Geometrical* Certainty: And if the like could be performed for *Cold*; which is ſomething elſe than the bare Abſence of the Sun (as appears by many Inſtances) we might hope to bring what relates to this Part of *Meteorology* to a perfect *Theory*.

Accidents by Thunder *and* Lightning *at* Oxford; *by Dr.* Wallis, n.

LIX. 1. *May* 10, 1666. About five of the Clock in the Afternoon, the *Thunder* (which I had heard before at ſome Diſtance) coming nearer to us, it began to *rain*; and ſoon after (the Rain withal increaſing) the *Thunder* grew very loud and frequent, and with long rattling *Claps* (tho' not altogether ſo great, as I have ſometimes heard:) And the *Lightning* with *Flaſhes* very bright (notwithſtanding the clear Day-light) and very frequent; when at the faſteſt, ſcarce a full Minute between one *Flaſh* and another; many Times not ſo much, but a ſecond *Flaſh* before the *Thunder* of the former was heard: The *Thunder*, for the moſt Part, began to be heard about eight or ten ſecond-Minutes after the *Flaſh*; as I obſerved for a great Part of the Time by my Minute-watch; but once or twice I obſerved it to follow (in a Manner) immediately upon it, as it were, in the ſame Moment; and the *Lightning* extreme *red* and fiery; ſo that had it been by Night as it was by Day, it would have been very terrible: And though I kept within Doors, yet I ſenſibly diſcover'd a ſtinking *Sulphurous* Smell in the Air. About ſeven of the Clock it ended, before which Time I had News brought me of a ſad Accident upon the Water at *Medley*, about a Mile, or ſomewhat more, diſtant from hence. Two Scholars of *Wadham-College*, being alone in a Boat (without a Waterman) having newly thruſt off from Shore, at *Medley*, to come homewards, ſtanding near the Head of the Boat, were preſently with a Stroak of *Thunder* or *Lightning*, both ſtruck off out of the Boat into the Water, the one of them ſtark dead, in whom, though preſently taken out of the Water (having been, by Relation, ſcarce a Minute in it) there was not diſcerned any Appearance of Life, Senſe, or Motion: the other was ſtuck faſt in the Mud, with his Feet downwards, and his upper Parts above Water, like a Poſt, not able to help himſelf out; but, beſides a preſent Stunning or Numbneſs, and no other Hurt; but was for the preſent, ſo diſturbed in his Senſes, as that he knew not how he came there out of the Boat, nor could remember either *Thundring* or *Lightning* that did effect it; and was very feeble and faint upon it: which (though preſently put into a warm Bed) he had not thoroughly recovered by the next Night; and whether ſince he have or no, I know not.

Others in another Boat, about ten or twenty Yards from theſe (as by their Deſcription I eſtimate) felt a Diſturbance and ſhaking in their Boat, and one of them had his Chair ſtruck from under him, and thrown upon him, but had no Hurt. Thoſe immediately made up to the others, and ſome (leaping into the Water to them) preſently drew them either into the Boat or on Shore; yet none of them ſaw theſe two fall into the Water (not looking that Way) but heard one of them cry out for Help preſently upon the Stroke, and ſmelt a very ſtrange *ſtinking Smell* in the Air, ſuch as is perceived upon the ſtriking of *Flints* together.

He that was dead, was the next Morning brought to Town; and Dr. *Willis*, Dr. *Millington*, Dr. *Lower*, and my ſelf, with ſome others, went to view the Corps, where we found no *Wound* at all in the Skin, the Face and Neck ſwarthy and black, but not more than might be ordinary by the ſettling of the Blood: On the Right-ſide of the Neck was a little blackiſh Spot about an Inch long, and about a Quarter of an Inch broad at the broadeſt, and was as if it had been *ſear'd* with a hot Iron; and, as I remember, one ſomewhat bigger on the Left-ſide of the Neck below the Ear. Straight down the Breaſt, but towards the Left-ſide of it, was a large Place, about three Quarters of a Foot in Length, and about two Inches in Breadth, in ſome Places more, in ſome leſs, which was burnt and hard, like Leather burnt with the Fire, of a deep blackiſh red Colour, not much unlike the ſcorched Skin of a roaſted Pig: and on the Fore-part of the Left-Shoulder ſuch another Spot, about as big as a Shilling; but that in the Neck was blacker, and ſeemed more ſear'd. From the Top of the Right Shoulder, ſloping downwards towards that Place in his Breaſt, was a narrow Line of the like ſcorched Skin; as if ſomewhat had come in there at the Neck, and run down to the Breaſt, and there ſpread broader.

The Buttons of his Doublet were moſt of them off; which ſome thought might have been torn off with the *Blaſt*, getting in at the Neck, and then burſting its Way out: For which the greateſt Preſumption was (to me) that, beſides four or five Buttons wanting towards the Bottom of the Breaſt, there were about half a Dozen together clear off, from the Bottom of the Collar downwards; and I do not remember, that the reſt of the Buttons did ſeem to be near worn out, but almoſt new. The Collar of his Doublet, juſt over the Forepart of the Left Shoulder, was quite broken aſunder, Cloth and Stiffning, ſtraight downwards, as if cut or chopp'd aſunder by a blunt Tool; only the inward Linen or Fuſtin-Lining of it was whole; by which, and by the View of the ragged Edges, it ſeemed manifeſt to me, that it was by a Stroak inwards from without, not outwards from within.

His Hat was ſtrangely torn, not juſt on the Crown, but on the Side of the Hat, and on the Brim. On the Side of it was a great Hole, more than to put in one's Fiſt through it; ſome Part of it being quite ſtruck away, and from thence divers Gaſhes every way, as if torn, or cut with a dull Tool, and ſome of them of a good Length, almoſt quite to the Edges of the Brim. And beſides theſe, one or two Gaſhes more, which did not communicate with that Hole in the Side. This alſo I judged by a Stroak inwards; not ſo much from the View of the Edges of thoſe Gaſhes (from which there was ſcarce any Judgment to be made either way) but becauſe the Lining was not torn, only ripp'd off from the Edge of the Hat (where it was ſew'd on) on that Side, where the Hole was made. Yet his Hat not being found upon his Head, but at ſome Diſtance from him, it did not appear againſt what Part of the Head that Hole was made.

The Night following, the three Doctors above-mentioned, and my ſelf, with ſome Chirurgeons (beſides a Multitude of others) were preſent at the opening of the Head, to ſee if any Thing could be there diſcover'd; but there appear'd no Sign of *Contuſion*; the *Brain* full and in good Order; the *Nerves* whole and ſound; the *Veſſels* of the *Brain* pretty full of Blood. But nothing was by any of them diſcern'd to be at all amiſs. Some of them thought, that they diſcern'd a ſmall *Fiſſure* or Crack in the *Skull*; and ſome who held it while it was ſawing off; ſaid, they felt it jarring in their Hands, and there ſeemed to the Eye ſomething like it; but it was ſo ſmall, as that, by Candle-light we could not agree it certainly ſo to be.

Some of the *Hair* on the Right Temples was manifeſtly ſinged or burnt, and the lower Part of that Ear blacker than the Parts about it, but ſoft; and it might be only the ſettling of the Blood. The upper Part of the Left Shoulder, and that Side of the Neck, were alſo ſomewhat blacker than the reſt of the Body; but whether it were by the Blow, which broke the Collar, and *ſcorched* the round red Spot thereupon, or only by ſettling of the Blood, I cannot ſay; yet I think it might very well be, that both on the Head and on this Side of the Neck, there might be a very great Blow, and a *Contuſion* upon it (and it ſeems to have been ſo, by the tearing of the Hat, and breaking the Collar, if not alſo cracking of the *Skull*) and yet no Sign of ſuch *Contuſion*, becauſe dying ſo immediately, there was not Time for the Blood to gather to the Part, and ſtagnate there (which in Bruiſes is the Cauſe of Blackneſs) and it was but as if ſuch a Blow had been given on a Body newly dead, which does not uſe to cauſe ſuch a Symptom of a Bruiſe, after the Blood ceaſes to circulate.

Having done with the *Head*, they opened the *Breaſt*, and found that *Burning* to reach quite through the *Skin*, which was, in thoſe *ſcorch'd* Places, hard and horny, and ſhrunk up, ſo as it was not ſo thick as the ſoft *Skin* about it: But no Appearance of any Thing deeper than the *Skin*; the Muſcles not at all diſorder'd or diſcolour'd (perhaps upon the Reaſon that was but now ſaid, of the Head, Neck and Shoulder.) Having then taken off the *Sternum*, the *Lungs* and *Heart* appear'd all well, and well colour'd without any Diſorder.

In Hampſhire; by Mr. Tho. Neale, n. 24. p. 247. 2. *Jan.* 24, 166$\frac{5}{6}$. One Mr. *Brooks* of *Hampſhire*, going from *Wincheſter* towards his Houſe near *Andover*, in very bad Weather, was himſelf ſlain by *Lightning*, and the Horſe he rode on, under him. For about a Mile from *Wincheſter* he was found with his Face beaten into the Ground, one Leg in the Stirrup, the other in the Horſes Mane, his Clothes all *burnt* off his Back, not a Piece as big as a Handkerchief left entire, and his *Hair* and all his Body *ſinged*; with the Force that ſtruck him down, his Noſe was beaten into his Face, and his Chin into his Breaſt, where was a *Wound* cut almoſt as low as to his Navel. The torn Pieces of his Clothes were ſo ſcatter'd and conſumed, that not enough to fill the Crown of a Hat could be found. His Gloves were whole, but his Hands in them *ſinged* to the Bone. The Hip-bone and Shoulder of his Horſe *burnt* and *bruiſed*, and his Saddle torn in little Pieces. This was what appeared to the *Coroner's Inqueſt*.

At Stralſund in Pomerania; by ---- n. 65. p. 2084. 3. *June* $\frac{19}{29}$, 1670. (being *Sunday*) After ſeveral leſs ſtrong Reports of *Thunder*, the whole Town, and particularly the Congregation in St. *Nicholas Church* (when the Miniſter was Preaching) was ſtrangely ſurpriſed with a moſt terrible Flaſh of *Lightning* and a fearful *Thunder Clap*, which lighted down through the leſſer Steeple upon the Body of the Church, and through the large round Hole in the upper Vault within the ſame, in the Shape (as ſome obſerv'd) of a black fiery *Ball*, directly upon the Altar, cauſing ſuch an hideous Crack, Fire-flaſh, Smoak, and Damp there, as if many Fire-Balls had been thrown down thither from the ſaid Vault, and burſted all at once, begetting a diſmal Conſternation among the People, and leaving an ill *ſulphurous* Smell behind.

The Candle on the South-ſide of the Altar was put out by the Blow; the other remained burning. Two of the *Chalices* there were overthrown, and the *Wine* ſpilt, and the *Wafers* ſcatter'd about: But the empty *Chalice* ſtood firm. All three were ſomewhat *ſmutted* at the Foot, and one of them a little bent there, and in two Places pierced thro', as if it had been by Hail-ſhot: and the *Wafer-boxes* were likewiſe a little ſmutted towards the Bottom. The *Church-Book* was flung on the inner Paſſage: The Covers of the Altar were ſinged in divers Parts, as by Powder, and ſomewhat burnt and ſmutted here and there, as alſo torn in ſome Places. A ſtrong Piece of *Wainſcot* with a Picture upon it, behind the great Altar, was ſplit in two. Of the *Church-Clock*, in the *Weſt-End*, at the ſame time, both the Braſs and Iron Wires of the Whole and Quarter-hour Hammers were partly broken, and the reſt could not be found; and an oaken Poſt, fix'd in the Wall for the Support of the Dial. was half torn, and beneath the ſame divers Bricks were ſtruck out of the two Head Pillars ſupporting the Steeple. On the Top of the Southern Steeple, an oaken Gutter and a ſtrong Beam and Supporter were ſhatter'd.

One of the Miniſters, though ſitting near the Altar to the South, had no Hurt at all. Divers of the People ſeated round about the Altar, fell down to the Ground with the Fright. One Youth that ſtood next the ſaid Miniſter's Pew, not being able to recover his Senſes, was carried home. On the North Side of the Altar four Perſons fell down, and one of the oaken Seats being ſplit under him that ſat thereon, that Perſon was much hurt by it, and more than any other. Some that ſtood in or by the Belfrey, near the Clock, were ſlightly hurt here and there; and among them a Mariner, leaning on a lined oaken ſeat there, had his right Arm bruiſed; and another Man, though but ſlightly hurt, yet could not remember how he got home from Church.

There iſſued forth a huge Damp like unto Smoak out of the Southern Steeple; but the *Church-Carpenter*, upon ſearch, met only with a preſent Noiſe and thick Damp, which, tho' it frighted him at firſt into an Apprehenſion of *Fire*, yet getting to the Windows, and opening them, the Damp iſſued with great Violence; but there appear'd no Fire any where, ſave only a little in the ſhatter'd Parts of the Steeple, which was ſoon quenched.

The Church-Dial was alſo ſmutted in ſundry Parts, ſoiling the gilt Figures, that they could ſcarce be diſcerned. The gilt Weather-Cocks upon both the Steeples were likewiſe ſmutted on the one Side of their Tails, without any other Mark. Nor could it be in the leaſt diſcovered in either of the Steeples, which way the Claps entred, by all the Search that was made.

It was obſerv'd afterwards, that among the eight Perſons that were hurt, one who ſtood in the Belfrey, had the upper back Part of his Cloth-Coat, as alſo his Shirt and Skin ſomewhat torn; but the Lining of that Coat, which was Red-Frize, had no Hurt at all.

Another ſitting betwixt the reſt, in a Pew under the Organs, and leaning on the Door, whilſt the Pew-lock (then cloſe to his Body) was ſo violently ſtruck out, that it hung only by one Nail, had no Damage at all by it himſelf, nor any other that ſate or ſtood by there, when the Stroak happen'd; though they fell all to the Ground by the Fright, at the Inſtant when it was given.

And as for him that had his Arm bruiſed, it was ſomewhat ſtrange that afterwards there was found a Hole paſſing his Coat, Waiſt-coat and Shirt, on the Fore-part of his Body, without in the leaſt hurting the Body; the Hole appearing juſt as ſhot through. His Waiſt-coat (being of a red Sarcenet) kept its Colour every where, but at the Place where the Arm was hurt: And the ſmall Silver-Edging was ſmutted almoſt every where, and about the Neck too, where the Party wore a Cravat. One half of his Shoe was alſo torn off, the Soal being pierced as with Hail-ſhot; and a Piece of his Stocking's Foot on the ſame Foot ſtruck away, near an Hand-breadth, without any other Hurt to either Foot or Leg, but that for ſome Days that Foot was benumbed.

Laſtly, One of them that ſat by the Altar, had his Breeches and Leather-Drawers on both Sides pierced through as by Hail-ſhot, and Part of it plainly ſcorch'd and ſhrunk up, as by *Fire*: And divers of ſuch ſmall Holes in his Shirt too, yet without any hurt in his Body, ſave that he found ſome Pain in his Foot. One Side of his Shoe was alſo torn, and the Soal ſidewards pierced through, as 'twere, with Hail-ſhot.

At Dantzick; *by Mr.* Chr. Kirby, n. 96. p. 6092.

4. About the latter End of *March* and *April*, 1673. we had much and violent *Thunder* and *Lightning*, which had this unhappy Effect upon all the Parcels of *Wheat* and *Rye*, of the laſt Year's-Growth, in our Granaries, that, tho' over-night they were dry, ſweet, and fit for Shipping, the next Morning they were become clammy and ſtinking; ſo that the *Owners*, if they would not loſe their Grain, were forced to cauſe it to be turned over two or three times a Day; and yet it required ſix Weeks, if not longer, before it was recovered. This is a Thing which often happens to Corn that hath not lain in the Granary a whole Year, or not ſweat thoroughly in the Straw before it be thraſh'd out.

At Portſmouth; *by* - - - n. 177. p. 1212.

5. *Octob.* 23, 1685. On Board the *Royal-James*, a Flaſh of *Lightning* and *Thunder* together took the Maſt, which was put into her for careening, being a made Maſt, and bound with Iron Hoops from one End to the other, and ſhiver'd it down to the Deck, breaking one of the Iron Hoops in the Body of the Maſt, ſo that Splinters are forc'd out of the Middle of the Maſt a Foot and half long (and a *Ball* of *Fire* was ſeen to run to and fro on the Deck) inſomuch that the Maſt is wholly unſerviceable, and muſt be taken out.

On Board the *Coronation*, notwithſtanding the Ship's Head was to Windward, a great *Ball* of *Fire* came into the Gun-room Ports, and threw a Boy out of one of the Ports, and he was drowned; and ſeveral Work-men being on Board, as Carpenters, Joyners, and Seamen were ſtruck down and made ſenſeleſs for ſome time; and the *Ball* of *Fire* ran up and ſtruck on the Starboard-ſide of the Wardrobe, and left a Place ſcorched round upon the Side, and between the two Ring-bolts, as if it had been a Shot, and beat the Wainſcot over to the Side, all ſcorch'd as if with Fire; and run up againſt the Doors and Hinges, away, and run into ſeveral *Balls* of *Fire* on the Deck amongſt the Men; and ſome Part of it broke in at the Windows of the Round-houſe, and ſhiver'd off a great deal of the Wainſcot, and broke the Glaſſes of the *Perſpective-Glaſs*, and make a *Hole* through a Letter that lay in the Window eight double, the Circumference of a Musket-Bullet, and no more; it alſo ſhivered the Timber that holds the *Enſign-Staff* on the *Poop*.

6. *March* 20, $169\frac{2}{3}$. About eight at Night there aroſe a very violent Guſt of Wind at South-weſt, which laſted an Hour and an half, during which time it rain'd very faſt. A Quarter of an Hour, or thereabout, after Nine, fell a mighty Storm of Hail intermixt with Rain, which lay very white, and ſome Depth on the Ground, and to me appeared to have Snow mixed with it. During that Storm happen'd two *Flaſhes* of *Lightning*, very violent and ſtrange; it was extraordinary blue, and of a ſulphurous Smell; it ſeemed to ſtand ſtill in the Houſe ſome conſiderable time, and was ſo great, that a Gentleman, who ſat below Stairs, thought that the Houſe had been on *Fire* above, and that the Flames rolled down Stairs. The Clap of *Thunder*, which immediately followed, ſeemed to all like the ſudden Diſcharge of five or ſix Field-pieces; not with that rolling deep Noiſe *Thunder* uſually carries along with it. The ſecond *Flaſh* and *Clap* followed within a few Minutes of the firſt, but not with that Violence as the former: Which Flaſh fired the Steeple, I cannot ſay, but a Piece of Wood to which the Lead of the Windows was nailed, was ſet on fire, and kindled very faſt, and might have done a great deal of Miſchief, had not the Earlineſs of the Night and timely Help prevented it. This Storm ſeemed to run in a direct Courſe; for ſeveral of our Side Towns perceived little of it; and I believe it broke chiefly over us. At *Kettering* one of their Bells, as ſome ſay, received ſome Damage, and the Wires of the Chimes were twiſted one with another. The Wind was very bluſtering all the Night after.

At Oundle by Mr. W. R.

7. *Aug.* 13, 1693. About three a Clock in the Morning it began to thunder and lighten, and rain; about four a Clock came a Clap of *Thunder* and *Lightning* all at the ſame Moment of Time, that was ſo ſmart and violent, that I thought the Ship had been ſplit in pieces; an Alarm went preſently through the Ship, of *Fire, Fire*, the dreadfulleſt Word that can happen on Board, and put us all into Confuſion. But it happen'd to rain briskly about that time, and ſo with the help of our Buckets, the Fire, which was occaſioned by the *Balls* of *Lightning* that came between Decks, was ſoon put out. In the *Gangway* was one Man knock'd down, and lay ſometime before he recovered himſelf; a ſecond near him was blown almoſt the Length of the Quarter-deck; a third was burnt all down his Back with the *Lightning*, in his Hammock. Our *Main Top-Gallant-Maſt* was ſplit in pieces, our *Top-maſt* not touched; our *Main-maſt* ſplit from the Top down to the very Deck.

On Board the Suffolk *in the Bay of* Biſcay; *by Dr.* Oliver, n. 204. p. 911.

8. *July* 24, 1696. We had an extraordinary pleaſant Forenoon, with continual Sun-ſhine, till about half an Hour after three in the Afternoon, when we had ſome Rain, after which happened two *Claps* of *Thunder*, though not very great, and then a great Shower of *Hail*, in which time happen'd a third *Clap*, which made all our loſs. We were ſixteen in Number, none of us happening to be out or abſent at the Time. The moſt Part of them were ſtanding

Near Aberdeen *in* Scotland; *by* n.222.p.311

ing about me in the School, hard by my Chamber-door; the two foreſaid Claps of *Thunder* being over, we thinking nothing of them; and now there being a great Shower of *Hail*, on a ſudden there happen'd ſuch a *Flaſh* of *Lightning*, which I ſaw, and, as I thought, fill'd the whole Houſe; but of the *Clap* I minded nothing, but only I think that I heard, as it were, ſome ſharp Clink or Sound; but our Neighbours in the Town, ſuch as the Miniſter and his Wife, told, they never heard a louder: But however, I think all our Loſs was by the *Fire*, which was over in an Inſtant, and after which we had Darkneſs in the *School*, by Reaſon of the *Smoak*, with a moſt violent ſulphurous Smell, and the burning of ſome Leaves of Books. There are five Breaches in the Walls, one in the Roof, exactly in ſhape like a Cannon-ball, another under the Chimney, a third came through the back Wall, and quite thro' the other Wall oppoſite it; and the Chimney was ſplit in pieces, and ſome that came to the School-Door, and made a Breach there, rending the Stones in pieces, and carrying them out. There were four kill'd, and many of the reſt hurt, having their Legs or Arms ruined; but are all, I thank God, recovered. And as for my ſelf, I never was in greater Danger; for there was one kill'd before me, another at my Left-hand, and not half a Foot from me there was a Breach made in the middle Wall of my Chamber; and yet I thank God, I received no Hurt, only I was bled in the Mouth, but how, I cannot tell. As to the Children's Bodies that were kill'd, I found none of their Bones broken; my Brother had a Cut in his Head; and all of them, where they received the Strokes, had their Clothes cut, as if it had been eat out with Rats. They all received their Strokes on their vital Parts, and about their Shoulders, which were in Colour of a browniſh-black. All the Children that were killed, were in different Places, and, as it were, pick'd out.

At Smyrna, by Mr. R. Mawgridge, n. 235. p. 782.

9. *Nov.* 26, 1696. A ſad and aſtoniſhing Accident happened to the *Trumbull Galley* by *Lightning* and *Thunder*. For as we lay at Anchor at *Smyrna*, about one of the Clock in the Morning, ſhe was ſtaved in ſeveral Places; the *Bulk-head* of her *Round-houſe* was ſtaved all to pieces into the Captain's Cabbin, and hurt his Shoulder; her *Mizzen-Maſt* was ſtaved all to pieces, and the *Spindle* in the Head of the Maſt was melted at both Ends with the *Lightning*; the *Main-Top Sail-Yard* was laſhed in the Top, yet notwithſtanding the *Yard* was thrown out, and ſtuck in our *Awning* right an End. The Quarter-Maſter (one *John Page*) was on the Deck by the *Mizzen-Maſt*, and one *John Allen*, who were both ſtruck down flat thereon with the *Lightning*. *Page* had one Side of him ſtupified for three Days, but, under God, I recovered him in ſix Days; *Allen* was very well the next Day, when his fright was over. The *Lightning* did ſtrike the Plank for ſix Foot off the Outſide of the Galley all to pieces, and the Timber was like a Bruſh; and three Planks of the Cieling were ſtarted, whereof two Foot and ſeven Inches was ſtaved out from the reſt, within ten Inches of my Head. My Velvet Cap was hanging on a Nail in the ſame Piece of Cieling, the Inſide whereof, next unto the *Lightning*, had not one Stitch amiſs, but the Outſide had all the Seams burſt to pieces. A great weighty Nail was ſtarted out of the ſaid Cieling, and fell over my Head, and lay upon my Pillow, and I thought my Head with the

Lightning had been in a Flaſh of Fire. Whilſt I could but juſt ſhut my Eyes and open them again, the *Lightning* went down into the Hold, and ran out like a Train of *Wild-fire*, and burſt out through the Galley's Side, and rent ten or eleven Foot of the outſide Plank off, within a Foot of the Water's Edge. Some of the *Lightning* ſhot up between the Timbers and the Cieling into the Gun-Room, and ſtaved a Beam, and ſet three or four Bundles of armed Match all on Fire. The Gunner, *George Hardy*, was lying in his Cabbin at the ſame time, and the *Lightning* bliſtred one of his Feet, and ſing'd his Hair off his Head. The Maſter's Cabbin was between the Gunner's and mine, but had no Damage.

In Northamptonſhire; *by Dr.* Wallis, n. 236. p. 5.

10. *July* 27, 1691. In *Everdon* Field, near *Daventry* in *Northamptonſhire*, divers were at Work reaping Corn. The Morning was fair and clear; but before Noon there came a violent Storm of *Thunder* and *Lightning* and *Rain*; which cauſed the Reapers being about twenty in all, to retreat for Shelter to a *Quickſet Hedge*, with a Ditch by the Side of it. Of theſe Perſons four were kill'd, *viz. Simon Marriot*, *Robert Marriot*, *Richard Wells*, and *Thomas Burroughs*; and eight others dangerouſly hurt: of the reſt ſeveral were ſtruck down, but not much hurt.

Upon the firſt Tidings of this Accident, Mr. *Edwards* (the Miniſter of *Badby*) repaired to the Place; where *Robert Marriot* lay on his Back out of the Ditch, having ſtruggled (as was ſaid by the By-ſtanders) after the Stroke. Mr. *Edwards* ſays, he ſaw no Marks or Sign of Hurt on the Body: But the Woman who laid him out, and the reſt, ſay, there was a *Hole* about the Bigneſs of a Gooſe-ſhot in the Pit of his Stomach, and many more about his Legs. There was in the Hedge a Pollard-Aſh, under which ſat *Simon Marriot* and *Richard Wells*; but *Thomas Burroughs* ſat at the Diſtance of two or three Yards from thence. In this Tree were cut or raſed four (or more) Grooves or Furrows, from the Top to near the Bottom, deeper than the Bark, and about an Inch broad, each of them, on that Side of the Tree on which the Men ſat; but no Damage appeared on the Tree elſewhere, there being a Knot on the oppoſite Side, which is ſuppoſed to have diverted the Stream of the fiery Matter. The green *Thorns* were ſcorched, and the Place ſmelt rank of *Sulphur*.

Simon Marriot had the Crown of his Hat cut into the Shape of a bearded Arrow, and at the Band-place cut ſmooth, almoſt round about from the Brim. His Clothes on one Shoulder cut jaggedly to the Skin, where was a Scar about four Inches in length, of a long oval Figure, the tranſverſe Diameter whereof was deepeſt, of a darkiſh red Colour, as hard as *Horn* all over. He had Snuff on his Hand, as if juſt ready to take it.

Richard Wells had a little Dog on his Lap, or between his Legs, dead. His Hand upon the Dog's Head, his Eyes open, and with Bread and Cheeſe (or one of them) in his Hand, as if going to give the Dog a Bit. His Shoulder (as his Relations ſay) was ſtruck down, and in a manner ſevered from his Body.

Thomas Burroughs ſat as looking up to the Heavens, his Head turning toward one Side, as viewing the Clouds; his Eyes open. He had in his Pocket a Copper Tobacco-Box, which had one little round Hole ſtruck quite thro' it; and a little of the Metal on one Side ſeemed to have run. By theſe Poſtures it is evident they died in a Moment.

Mr. *Edwards* adds, that he took *Simon Marriot's* Hat, and ſome of his Clothes, and held them againſt the Light, and they appeared full of Holes, as a Skimmer or Cullendar. But (at which he wondred moſt) the Woman who laid them out, told him, their Buttocks which ſat upon the Ground were pitifully mangled, and their Privy-Members rent and torn to pieces; and more eſpecially thoſe of *Thomas Burroughs*, as if ſmall Bars of red hot Iron had been thruſt up into them in many Places.

The Hair of their Heads was burnt very much. Some had no Harm that were hard by: But others were wounded at a Diſtance, and their Wounds were cured with more Difficulty than ordinary Burns.

It was (before the Storm) a pretty ſtill Day. But before each *Thunder Clap*, was heard a great whirling Noiſe in the Trees, like Wind. The *Lightning* was obſerved by Perſons at a Diſtance, all falling perpendicularly upon them. Thoſe who recovered had their Clothes full of Holes, as if they had been ſhot through. Not a Drop of Blood appear'd upon any of them. Their Hurts were like dry, ſcorched, ſcarred, or healed Wounds.

Simon Marriot and *Robert Marriot* were ſtruck back; the other two, ſupported, as is ſuppoſed, by the Hedge at their Back, continued in the Poſture wherein they were kill'd, three or four Hours after, when Mr. *Richard Butler* of *Preſton* ſaw them.

Several of thoſe who were hurt, were taken up for dead, but ſoon came to themſelves without any Application: But ſome of them were fain to be carried home.

William Gregory's Wife had four little Holes in her Knee, like Shot-holes; which turned to Sores, and had Cores come out of them.

Mary Bird (a Woman with Child) had, all over her Body near an hundred *Wounds*, ſome as large as a Man's Hand, on each Arm one, and one on each Side of her Belly. Out of moſt of her Wounds came *Cores*, ſome bigger, ſome leſs; the biggeſt were bigger than a Walnut, dry and black like Leather. She had two Sores on the Soles of her Feet, but her Shoes and Stockings not touched. She ſate next to thoſe that were kill'd. She was taken out of the Ditch for dead, and was ſuppos'd to be kill'd. She was ſenſible of the Stroke, and ſenſible that her Husband look'd pale, and then ſwooned away. She and her Husband were both blooded, ſhe within an Hour after, and her Husband eight Hours after; and they bled freely. Their Legs were mightily ſwell'd before they were carried out of the Field. The Woman was very ſore, and full of Pain, ſo that ſhe could hardly bear any Clothes to touch her. She was three Weeks ill before ſhe could riſe, and continued ill about a Quarter of a Year. No Medicines uſed for Burns did any good, but occaſioned great Torment to her. The firſt that they perceived to do good to her was Oil of St. *John's-Wort*, and after the Cores were come out, the *Black-Salve*. She went out her full Time: The Child had no Marks or Blemiſh at all upon this Occaſion, and is yet living. About that Time of the Year ſhe hath been blooded ever ſince. She finds a great Tingling, and hath little Pimples like Stinging of Nettles, and cannot be well until ſhe hath been blooded.

The Wounds of all thoſe that were hurt, were like thoſe of this Woman, but ſlighter; and ſome of them had no Cores come out of them.

This is the beſt Account I can give you out of the broken Remarks which I had in Writing from Mr. *Edwards* and Mr. *Butler*, the two Gentlemen above mentioned.

In York-ſhire, 1698. *by Mr* Ral. Thoresby, n. 249. p. 51.

11. *Dec.* 22, 1698. *Jeremiah Skelton* at *Warley*, in the Vicarage of *Hallifax* in *Yorkſhire*, obſerving a Storm coming upon him, ſtepp'd aſide for Shelter within a Barn-Door, and while there, was ſtruck with a dreadful *Flaſh* of *Fire*: A young Woman that lived with her Father, in the Houſe that belonged to this Farm, being ſadly affrighted with the *Thunder* and *Lightning* (for Part of the ſulphurous Matter came down the Chimney, and filled the Houſe with a ſtrong Scent, like that of Gun-powder after firing) ſhe leaves the Houſe, and not ſeeing the young Man about the Barn, goes with Speed, and tells the Family he was related to, that ſhe fear'd he was ſlain. They came to the Barn, and found it even ſo: A ſad Spectacle! the young Man caſt down, and many Stones about him; he was laid upon his Face, wholly naked, ſave a ſmall Part of his Shirt about his Neck, and a very little of a Stocking upon one Foot, and ſo much of a Coat-Sleeve as covered the Wriſt of one Arm; his Clogs driven from his Feet, one not to be found, and the other cloven; his Hat not to be found after Search, and the reſt of his Garments torn into ſmall Shreds, and caſt at conſiderable Diſtances one Bit from another; the *Hair* of his *Head* and *Beard* ſinged, as though it had been with a Candle, and a little Hole below his left Eye, which they ſuppoſed might be made with the Fall upon a Stone; for there was a great Breach made upon the Barn, the Door-tops, both of Stone, broken, and the Wall above them fallen, with the Slate and Water-Tables.

In York-ſhire, 1700; *by Mr.* R. Thoresby, n. 264. p. 577.

12. *April* 27, 1700. We had (at *Leeds* in *Yorkſhire*) a pretty ſevere Storm of *Thunder* and *Lightning*; one Clap particularly was very loud, and ſeem'd to me to be very low and near us. It fell upon a Cottage, and broke down Part of the Chamber Chimney, and thence made its Way through a Chink or Nick in the Floor to the lower Room, whereby the Flame thus contracted was either more intenſely hot, or at leaſt directed more immediately to a Shelf, where it melted ſeveral Holes in two Pewter Diſhes; it melted alſo, and run into little Lumps, ſeveral Places in a Pewter Candleſtick, and of a Braſs Mortar, yet burnt not ſome Bits of Fringe, and other combuſtible Matters within it; it burnt alſo ſome Holes in a Tin Veſſel, and ſmutted a white Stone Plate it ſtood upon, as if it had been with *Lamp-Black*, and filled the Room with ſuch a *Bituminous Smell* (like fired Gun-powder) as almoſt ſtifled the poor Woman, who was all alone in the Houſe: But upon opening the Door, ſhe received no farther Damage. I bought the Candleſticks, to preſerve as a Memorial of ſo uncommon an Accident.

I have enquired of one in that Neighbourhood, concerning a more fatal Accident; of which the *Pariſh-Regiſter* has this Note.' *Sept.* 2, 1672. was buried *Thomas*, the Son of *James Lambert*, Junior, deceaſed, of *Holbeck*, ſlain the Day before, being the Lord's-Day, by a *Thunderbolt.* His Skin, as I am informed, was perfectly burnt black, and was ſhrunk up hard like Parchment, or Leather burnt with Fire. There were other Children in Company, who were alſo caſt down by the Storm, amongſt whom the Party I ſpoke to had a Brother and Siſter; he had a Pair of new Stockings burnt off his Legs, and himſelf was ſo ſcorched, that he never recovered his natural Complexion: She having a Waiſtcoat claſp'd before (as the Faſhion then was) was ſo burnt betwixt her Breaſts, that the Scars thereof remain to this Day: Another had the ſtiffned Neck of his Doublet ſtruck off.

But all recovered except *Lambert*'s Boy, who was found with his Face upwards, whereas all the reſt had theirs to the Earth: Which reminds me of our Coal-Miners Practice, who, when any ſwoon away by their ſulphurous Damps, dig a *Hole* in the Earth, and lay them on their Bellies, with their Mouths in it, which, if it prove not an abſolute Suffocation, recovers them.

The Direction *of* Ship-Compaſſes *changed with* Thunder *and* Lightning; *by* . . n. 127. p. 647.

LX. 1. Mr. *Haward*, who has been Maſter of ſeveral Ships, and is a Man of good Credit, tells me, That in a Voyage to *Barbadoes*, in Company of another Ship, commanded by one *Grofton* of *New-England*, they were, in the *Latitude*, as I remember, of *Bermudas*, ſuddenly alarmed with a terrible *Clap* of *Thunder*, which broke this *Grofton*'s Fore-maſt, tore his Sails, and did ſome Damage to his Rigging: But by that Time the Noiſe, together with the Danger of this frightful Accident was paſt, Mr. *Haward*, to whom this *Thunder* had been more favourable, was however no leſs ſurpriſed, to ſee his Companion's Ship ſteer directly homeward again. When they were almoſt out of Call, he tack'd and ſtood after them, and found, That Mr. *Grofton* did indeed ſteer by the right Point of his Compaſs, but that the Card was turn'd round, the North and South Points having changed Poſitions; and though with his Finger he brought the *Flower de Lys* to point directly North, it would immediately, as ſoon as at Liberty, return to this new unuſual Poſture, and upon Examination, he found every Compaſs in the Ship of the ſame Humour: Which ſtrange and ſudden Accident he could impute to nothing elſe but to the Operation of the *Lightning* and *Thunder* newly mentioned. He adds, that he lent *Grofton* one of his Compaſſes to finiſh the Voyage, and withal, that thoſe *Thunder-ſtrucken* ones did never, to his Knowledge, recover their right *Poſitions* again.

By Sir R. S. n. 157. p. 910.

2. *July* 24, 1681. The Ship called the *Albemarle*, whereof Mr. *Edward Lad* was then Maſter, being a hundred Leagues from *Cape Cod*, in Lat. 488, about 3 h. *p. m.* met with a *Thunder-ſtorm*; the *Lightning* burnt the Main-Top-Sail, ſplit the Main-Cap in pieces, rent the Maſt all along: there was in ſpecial one dreadful Clap of Thunder, in Report bigger than that of a great Gun, at which all the Ship's Company were amazed; then did there fall ſomething from the Clouds upon the Stern of the Boat, which broke into

many ſmall Parts, ſplit one of the Pumps, and the other Pump much hurt alſo; it was a bituminous Matter, *ſmelling* much like fired Gun-powder: It continued burning in the Stern of the Boat; they did with Sticks diſſipate it, and poured much Water on it, and yet they were not able by all that they could do, to extinguiſh it until ſuch Time as all the Matter was conſumed.

When Night came, obſerving the Stars, they perceived that their *Compaſſes were changed*; as for the *Compaſſes* in the *Bittakle*, the *North-Point* was turned clear *South*. There were two other *Compaſſes* unhung in the Locker in the Cabbin, one of which the *North* Point ſtood *South*, like that in the *Bittakle*; as for the other, the *North* Point ſtood *Weſt*; ſo that they ſailed a thouſand Leagues by a Needle, whoſe *Polarity* was quite *chang'd*. As for the *Compaſs* wherein the *Lightning* had made the Needle to point *Weſtward*, ſince it was brought to *New-England*, the Glaſs being broken, it has, by means of the Air's coming to it, wholly loſt its Virtue.

Mr. *Edward Randolph* (who has been four times employed to *New-England*, in his Majeſty's Service) being enjoined by Mr. *Flamſteed* to make Enquiry into this Matter, at his Return to *Boſton* in *Dec.* 1683. ſpoke with Mr. *Lad* himſelf. He affirmed the ſame Thing, and dictated to him an Account ſuitable to what you have. But that which you have was in the Hands of Mr. *Mather*, a Miniſter, to whom Mr. *Lad* had alſo preſented one of the *Compaſſes*, as he had done the other to an *Engliſh Merchant* in *Amſterdam*, who gave it to the Statehouſe.

A Fiery Exhalation or Damp; *by Mr.* Maurice Jones, n. 208. p. 49.

LXI. 1. About *Chriſtmas* 1693. at *Harlech* in *Merionydſhire*, ſixteen Ricks of Hay, and two Barns, whereof one was full of Corn, the other of Hay, were ſet on Fire by a *kindled Exhalation*, which was often ſeen to come from the Sea, and laſted at leaſt a Fortnight or three Weeks; and it annoyed the Country, as well by *poyſoning* their Graſs, as *firing* the Hay, for the Space of a Mile, or thereabouts. Such as have ſeen the Fire, ſay it was a blue weak Flame, eaſily extinguiſhed, and that it did not the leaſt Harm to any of the Men, who interpoſed their Endeavours to ſave the *Hay*, tho' they ventured (perceiving it different from common Fire) not only cloſe to it, but ſometimes into it. All the Damage ſuſtained happen'd conſtantly in the Night. *Dec.* 24. *Richard Griffith* of *Lechwedh-du*, *Humphrey Owen* of *Garreg-wenn*, and *Richard Davydh* of *Erw-wenn*, each of them loſt a Rick of *Hay*. 27. That Night was burnt one Rick of *Hay* of *John Philips* of *Ynyſlarvihangel y Tralthau*, two Ricks of *Hay* of *Griffith John Owen* of *Cefn-Trevorbach*, and *Katharine Williams*, Widow of *Cefn Trefor fuawr*, loſt two Ricks. 29. That Night *Francis Evans* of *Glaſs-vryn* had one Rick burnt. *Richard Davydh* of *Erw-wenn*, had a Barn full of *Hay* of three Bays of Buildings, burnt down to the Ground.

There are three ſmall Tenements in the ſame Neighbourhood (call'd *Tydhin Sion Wyn*) whereof the Graſs is ſo *infected*, that it abſolutely kills all manner of Cattle that feed upon it. The Graſs has been *infectious* theſe three Years, but not thoroughly fatal till this laſt.

2. An

By Mr. Edw. Lhwyd, n. 213. p. 223.

2. An intelligent ſober Perſon that lives near *Harlech*, aſſures me, that the *Fire* ſtill [*Aug.* 1694] continues there; that it is obſerved to come from a Place call'd *Morva-bychan* in *Caernarvonſhire*, about eight or nine Miles off, [over Part of the Sea.] That Cattle of all ſorts, as Sheep, Goats, Hogs, Cows, and Horſes, ſtill *die* apace; and that for certain any great Noiſe, as Winding of Horns, Drums, &c. does *repel* it from any Houſe or Barn, or Stacks of *Hay*; upon Account of which Remedy they have had few or no Loſſes ſince *Chriſtmas:* That it happened, during this Summer, at leaſt one Night in a Week, and that commonly either *Saturday* or *Sunday*; but that now of late it appears ſomething oftner. The Place from whence it proceeds is both ſandy and marſhy.

Fairy Circles; by Mr. Jeſſop, n. 117. p. 394.

LXII. I have often been puzzled to give an Account of thoſe *Phænomena*, which are commonly called *Fairy-Circles*. I have ſeen many of them, and thoſe of two ſorts; one ſort *Bare*, of ſeven or eight Yards Diameter, making a round Path ſomething more than a Foot broad, with green Graſs in the Middle; the others like them, but of ſeveral Bigneſſes, and encompaſſed with a Circumference of Graſs, about the ſame Breadth, much *freſher* and *greener* than that in the Middle. But my worthy Friend Mr. *Walker*, gave me full Satisfaction from his own Experience. It was his Chance one Day to walk out among ſome Mowing Graſs (in which he had been but a little while before) after a great Storm of *Thunder* and *Lightning*, which ſeemed by the Noiſe and Flaſhes to have been very near him: He preſently obſerved a *round Circle*, of about four or five Yards Diameter, the Rim whereof was about a Foot broad, newly *burnt bare*, as the Colour and Brittleneſs of the Graſs Roots did plainly teſtify. He knew not what to aſcribe it unto but the *Lightning*, which, beſides the odd *Capricio's*, remarkable in that Fire in particular, might, without any Wonder, like all other Fires, move round, and burn more in the Extremities than the Middle. After the Graſs was mowed, the next Year it came up more *freſh* and *green* in the Places burnt, than in the Middle, and at Mowing-time was much taller and ranker.

The Cauſe *of* Lightning *and* Thunder *conſidered, by Dr.* Liſter, n. 157. p. 517.

LXIII. 1. There are two ſorts of Inſtances (that often occur in Hiſtory) which very much favour my Opinion, That *Thunder* and *Lightning* owe their Matter from the ſole *Breath* of the *Pyrites*.

The firſt ſort of them are thoſe which tell us, that in *Italy* it rained Iron in ſuch a Year, and in *Germany* a great Body of Iron-ſtone fell at ſuch a time; the like *Avicen* affirms. *Julius Scaliger* ſays, that he had by him a Piece of Iron which was rained in *Savoy*, where it fell in divers Places. *Cardan* reports 1200 Stones to have fallen from Heaven, and one of them weighed an hundred and twenty Pound, ſome of them thirty, ſome forty Pound, very hard, and of the Colour of Iron. Now that which is very remarkable (ſays *Gilbert*, where thoſe Inſtances are reckon'd up) and a very probable Argument for the Truth of ſuch like Inſtances, is, that it is no where recorded, that it ever rained Gold or Silver Ore, or Tin, or Lead; but Copper hath been alſo ſaid to have fallen from the Clouds.

But where-ever the *Pyrites* is mentioned by the Antients, it is always to be underſtood of the *Copper Pyrites*; they ſcarce having had any Knowledge of the *Iron Pyrites*. And therefore the raining of Copper makes it yet more probable, becauſe of its great Affinity with Iron.

Now this *Ferrum* or *Æs Nubigenum*, if there was ever any ſuch, was concreted of the *Breath* of the *Pyrites*, which we have elſewhere ſhewn to be the *Pyrites*, *ex tota Subſtantia*.

The other Inſtance (which is owing to our Regiſters) is of *Lightning* being *Magnetick*. This I am ſure of, I have a petrified Piece of Aſh, which is *Magnetick*; that is, the *Pyrites in Succo*; which makes it probable it may be *Magnetick* alſo in Vapour.

Vid. ſup. § LX.

2. *Thunder* and *Lightning* are ſo very like the Effects of fired *Gun-powder*, that we may reaſonably judge them to proceed from like *Cauſes*. Now the principal Ingredients in Gun-powder are *Nitre* and *Sulphur* (the Admiſtion of Char-coal being chiefly to keep the Parts ſeparate, for the better kindling of it) So that if we ſuppoſe in the Air a convenient Mixture of *Nitrous* and *Sulphurous* Vapours, and thoſe by Accident to take Fire, ſuch *Exploſion* may well follow, with ſuch Noiſe and Light, as in the firing of *Gun-powder*. And being once kindled, it will run from Place to Place, as the Vapour leads it, as in a Train of *Gun-powder*, with like Effects.

The Cauſe of Hail, Lightning, *and* Thunder *conſidered; by* Dr. Wallis. n. 231. p. 655.

This *Exploſion*, if high in the Air, and far from us, will do no Miſchief, or not conſiderable; like a Parcel of *Gun-powder* fired in the open Air, where is nothing near to be hurt by it: But if near to us (or amongſt us) it may kill Men or Cattle, tear Trees, fire *Gun-powder*, break Houſes, or the like; as *Gun-powder* would do in the like Circumſtances. This Nearneſs or Farneſs may be eſtimated by the Diſtance of Time between ſeeing the *Flaſh* of *Lightning*, and hearing the Noiſe of the *Thunder*. For though in their Generation they be ſimultaneous; yet (*Light* moving faſter than *Sound*) they come to us ſucceſſively. I have obſerved, that commonly the Noiſe is about ſeven or eight *Seconds* after the *Flaſh* (that is, about half a Quarter of a Minute) but ſometimes much ſooner, in a *Second* or two, or leſs than ſo, and almoſt immediately upon the *Flaſh*. And at ſuch time the *Exploſion* muſt needs be very near us, or even amongſt us. And, in ſuch Caſes I have (more than once) preſaged the Epectation of *Miſchief*, and it hath proved accordingly.

Now, That there is in *Lightning* a *ſulphurous Vapour*, is manifeſt from the *ſulphurous Smell* which attends it, and a ſultry Heat in the Air, which is commonly a Fore-runner of *Lightning* ſoon after. And that there is alſo a *nitrous* Vapour with it, we may reaſonably judge, becauſe we do not know of any Body ſo liable to a ſudden and violent *Exploſion*.

As to the *kindling* of theſe Materials, in order to ſuch *Exploſion*, I am told that a Mixture of *Sulphur* and *Filings* of *Steel*, with the Admiſtion of a *little Water*, will not only cauſe a great Efferveſcence, but will of it ſelf break forth into an actual Fire. I ſay, a *little Water*, becauſe too much will hinder the Operation, or quench the Fire, which I take to be the *Cauſe* of the *Bath*

n. 233. p. 729.

Waters, and other *hot Springs*, where *Steel* and *Sulphur* cauſe a great Efferveſcence, but no Flame.

n. 231. p. 657. So that there wants only ſome *Chalybeat* or *Vitriolick Vapour* (or ſomewhat *equivalent*) to produce the whole Effect (there being no want of aqueous Matter in the Clouds). And there is no doubt, but that amongſt the various *Effluvia* from the Earth, there may be copious Supplies of Matter for ſuch Mixtions.

n. 233. p. 730. The ſame Account may be alſo given of *Ætna* (and other *Burning-Mountains*) where the Mixture of *Steel* and *Sulphur* may give a *Flame*; which is oft attended with prodigious (*Exploſions* and *Earthquakes*) from great quantities of *Nitre*, as in ſpringing a Mine.

n. 231. p. 657. This may alſo ſuggeſt ſomewhat as to the *Generation* of *Hail*, which is very oft an Attendant of *Thunder* and *Lightning*. 'Tis well known, in our artificial *Congelations*, that a Mixture of *Snow* and *Nitre* (or even common Salt) will cauſe a preſent and very ſudden *Congelation* of *Water*. And the ſame in Clouds may cauſe that of *Hail-ſtones*. And the rather, becauſe there ſeems ſomewhat like *Snow*, rather than *Ice*, in the Midſt of them. And as to thoſe in particular ſo very large (as to weigh half a Pound, or three Quarters of a Vid. ſup. §. XLIV. Pound) ſuppoſing them to fall from ſo great a Height, as 'tis manifeſt they did by the Violence of their Fall; 'tis very poſſible, that, though their firſt Concretion, upon their ſudden *Congelation*, might be but moderately great, as in other *Hail*, yet in their long Deſcent, if the Medium through which they fall were alike inclined to *Congelation*, they might receive a great Vid. ſup. §. LI. Acceſſion to their Bulk, and divers of them incorporate into one: Like as in that ſtrange Shower of *Hail* in *December* 1672. wherein there did hang on the Trees a great deal in the Form of *Icicles*, a Foot or more in length.

n. 236. p. 9. Vid. ſup. §. LIX. 10. Theſe Conſiderations may alſo furniſh us with ſome Account of the *natural Cauſes* of thoſe particular Circumſtances which attended the Accident at *Everdon*, where four Perſons were kill'd, and others hurt with *Lightning*.

It ſeems to me, that in and over the Ditch there was Plenty of ſome *Cauſtick Vapour* of a like Nature with the Ingredients of *Gun-powder*; and perhaps even under thoſe who were killed or wounded. And if this *exploſive* Quality were attended with that of *Glaciation*, as *Thunder* is often accompanied with *Hail* (*Nitre* being a proper Efficient of both) there might be ſuch Concretions, in the Nature of *Hail*, as might (by ſuch *Exploſion*) be ſcattered like *Hail-ſhot* out of a Gun, and cauſe ſuch *Holes* as are ſaid to have been in the Clothes and Fleſh of thoſe Perſons. And what is ſaid to have been obſerved by others at a Diſtance, like a *Ball* of *Fire* falling down directly upon the *Place*, might, be a Propagation of the *Flame* kindled above, and continued, as the *Vapour* directed it to the Place (as would be in a Train of *Gun-powder*) and might there hurt ſome, and ſpare others, according as it was here or there more copious. For we are not to preſume that it was in all Places equally mixed.

The *Cores*, which came out of the Wounds, ſeem like *Eſcars* made by a

Cauſtick or other Burnings. And I take them to be ſcorched Skin, mortified, (beat into the Fleſh by that *Hail-Shot*) and appearing like burnt Leaves: Which muſt be worked out before the Wound could be healed; as is uſual, when other heterogeneous Matter is forced into the Fleſh.

That ſome of the People, not far off, might be thrown down, and not otherwiſe conſiderably hurt, is not ſtrange; who might be within the *Blaſt*, though not within the Reach of the Fire; as we ſee in the *Exploſion* of *Gunpowder* (to which I take this to be very like) when Windows (and other Things at a Diſtance) are ſhaken and ſhatter'd by the *Blaſt*, or great Concuſſion of the Air, though the *Flame* do not reach them.

LXIV. 1. *Decemb.* 25, 1666. In the Evening here (*viz* at *Madrid*) was a great *Halo* about the *Moon*; the Semidiameter whereof was about 23° 30′. *Aldebaran* was juſt in the North-Eaſt Part of the Circle, and the two *Horns* of *Aries* juſt encloſed by the South-Weſt of the Circle, the *Moon* being in the Center. I note this the rather, becauſe 5 or 6 Years ago, *viz. Nov.* 21, 1661. an Hour after Sun-ſet, I ſaw a great *Halo* about the *Moon*, of the ſame Diameter, at *Tangier*, the *Moon* being very near the ſame Place where ſhe was now.

Halo's, *At* Madrid; *by* *E. of* Sandwich, n. 22. p. 390.

2. *May* 12, 1667. An *Halo* or Circle about the *Sun*, was obſerv'd by the *Philoſophical Society* at *Paris*. The Diameter of this Circle was found to be of 44 *Degrees*, and the Breadth of the Limb thereof, about half a *Degree*. The upper and lower Part were of a *vivid red* and *yellow*, with a little *purple* Colour, but eſpecially the upper; the *red* was within the *Circle*. The other Parts appeared but *whitiſh*, and of little Clearneſs. The Space within the *Halo* was a little darker than that about it, eſpecially towards the Parts that were *coloured*. Beſides, there was ſeen the *Proportion* of another *great Circle*, which touched the *Halo* above, and whoſe Extremities were bent downward, as is repreſented in the *Figure*. This *Portion* of a *Circle* had alſo its Colours like thoſe of the *Halo*, but fainter. The Height of the *Sun* at the Beginning of the Obſervation, was about 46 *Deg.* There were in the Air little white Clouds, which ſomewhat tarniſh'd the blue Colour of the Heavens, and leſſened the Brightneſs of the *Sun*, which ſhone as in an *Eclipſe*. The Weather was cold, conſidering the Seaſon of the Year; and it was affirmed for certain, that it had *frozen* the Night before. This *Halo* appear'd in the ſame Beauty and Splendor of Colours unchanged from 9 in the Morning (when it began to be obſerv'd) until about half an Hour paſt 10; after which time it became fainter and fainter till two of the Clock in the Afternoon (when it ended) after it had reſumed a little more Force ſome time before it diſappear'd.

At Paris *by* M---- n. 60. p. 1065.

Fig. 26.

3. *Jan.* 1. *St. N.* 1676. H. 3. 46′. Durante *Eclipſi*, ingens *Halo Lunam* cinxerit.

At Dantzick; *by M.* Hevelius, n. 124. p. 589.

4 *Aug.* 21, 1676. At 12 h. 40′. At Night a *Halo* encompaſſed the *Moon*; in whoſe Circumference was *Saturn*, the *Pleiades*, *Capella*, and the *following* of the *Foot* of *Perſeus*.

At Oxford; *by Mr.* Halley, n. 129. p. 724.

Parhelia obſerved in France; by M.... n. 13. p. 219.

LXV. 1. *April* 9, 1666. About half an Hour paſt 9, there appeared three *Circles* in the *Sky*. *One* of them *S C H N*, was very great, a little interrupted, and *White* every where, without the Mixture of any other Colour. It paſſed through the Midſt of the *Sun*'s Disk, and was parallel to the *Horizon*. Its Diameter was above 100 *Degrees*, and its Center not far from the *Zenith A*.

Fig. 27.

The *ſecond D E B O*, was much leſs and defective in ſome Places, having the *Colours* of a *Rainbow*, eſpecially in that Part which was within the great *Circle*. It had the true *Sun R* for its Center.

The *third H D N*, was leſs than the *firſt*, but greater than the *ſecond*; it was not entire, but only an *Arch* or Portion of a *Circle*, whoſe Center was far diſtant from that of the *Sun*, and whoſe Circumference did, by its Middle, join to that of the *leaſt Circle*, with which it was confounded at *D*, and interſected the *greateſt Circles*, by its two Extreams. In this *Circle* were diſcerned alſo the *Colours* of a *Rainbow*, but they were not ſo ſtrong as thoſe of the *ſecond*.

At the Place, where the Circumference of this *third Circle* did cloſe with that of the *ſecond*, there was a great Brightneſs of *Rainbow-Colours* mix'd together: And at the two Extremities, where this *ſecond Circle* interſected the *firſt*, appeared two *Parbelia's* or *Mock-ſuns*, *H*, *N*; which ſhone very bright, but not ſo bright, or ſo well defined, as the *true Sun*. The Midſt of theſe two *falſe Suns* was *white* and very luminous; and their Extremities towards *D I*, were *tinged* with the *Colours* of a *Rainbow*. The *falſe Sun H*, that was towards the *South*, was bigger, and far more luminous than that towards the *Eaſt*.

There was alſo upon the *firſt* great *Circle*, a *third Mock-Sun*, *C*, ſituated to the *North*, which was leſs, all *white*, and far leſs ſhining than the two others. There was a Space very dark betwixt *R* and *D*.

This Appearance is look'd upon as one of the notableſt that can be ſeen, by Reaſon of the Eccentricity of the Circle *H D N*, and becauſe that the *Parhelia* were not in the Interſection of the Circle *D E B O*, with the great Circle *S C H N*, as they appear'd at *Rome*, *March* 29, 1629. but in that of the Semicircle *H D N*.

Carteſii *Meteor.* c. 10.

In Hungary; *by Dr.* Edw. Brown, n. 47. p. 953.

2. A Learned Jeſuit, call'd Father *Mcihael*, who lives at *Preſburgh*, communicated to me an Account of two *Parbelia's*, which were ſeen *Jan.* 30, 1669. *St. N.* about one of the Clock in the Afternoon, over the City of *Caſſovia* in *Hungary*.

There was one on each Side of the *true Sun*, and they were ſo reſplendent, that the naked Eye could not bear the Brightneſs thereof. *One* of them (the leſſer of the two) began to decay before the *other*, and then the *other* grew bigger, and continued well nigh two Hours, projecting very long Rays from it ſelf. They were *both*, on that Part which was towards the *Sun*, *tinged* with a pale *Yellow*, the other Parts being ſomewhat fuſcous. There were at the ſame time ſeen ſeveral *Rainbows*, together with the Segment of a great *white Circle*, of a long Duration, paſſing through the two *Parhelia's* and the *Sun*: And all this at a time, when the Air was almoſt free from Clouds, tho' here and there were ſcatter'd ſome very thin ones.

3. *An.* 1670. *Oct.* 11. *St. N. H.* 7. 40′ Tres *Parhelii* apparuerunt.

At Dantzick; *by* M. Hevelius, n. 66. p. 2026.

4. *Feb.* 5, 1674. *St. N.* Not far from *Marienburgh* in *Boruſſia*, I ſaw the *Sun* (in a Sky every where ſerene enough) being yet ſome *Degrees* above the *Horizon*, and ſhining very bright, yet launching out very long and *reddiſh* Rays, 40 or 50 *Degrees* toward the *Zenith*. Under the *Sun*, towards the *Horizon*, there hung a ſomewhat dilute ſmall Cloud, beneath which there appear'd a *Mock-Sun*, of the ſame Bigneſs (to Senſe) with the *true Sun*, and under the ſame Vertical, of a ſomewhat Red Colour. Soon after, the true Sun more and more deſcending to the *Horizon* towards the ſaid Cloud, the *ſpurious Sun* beneath it grew clearer and clearer; ſo that the *Reddiſh* Colour in that *apparent Solar* Disk vaniſh'd and put on the *genuine* Solar Light, and that the more, the leſs the *genuine* Disk of the *Sun* was diſtant from the *falſe Sun*; till at length, the upper *true Sun* paſſed into the lower counterfeit one, and ſo remained alone.

At Marienburgh *in* Boruſſia; *by* M. Hevelius, n. 102. p. 26. *Fig.* 28. *Fig.* 29.

Upon this Appearance there ſoon followed here an exceedingly intenſe and bitter *Froſt*, whereby the whole *Sinus Puzenſis* was *frozen* up, from this Town of *Dantzick*, as far as *Hela* in the *Baltick Sea*, which laſted unto the 25th of *March*; and the *Bay* was *frozen* ſo hard, that with great Safety People ran out into it with Sleds and Horſes, for ſeveral of our Miles. *Fig.* 30.

5. *Aug.* 28, 1698. About 8 a Clock in the Morning, ſome Perſons at *Sudbury* in *Suffolk*, ſaw the Appearance of *three Suns*; 'tis ſaid, then the Apparition was moſt full, or a little after. About half an Hour after 8, I my ſelf ſaw it; there was in the Eaſt, a dark, dusky, watry Cloud, and below it towards the Middle, was the *true Sun*, ſhining with fierce and piercing Beams, that Perſons could not look upon it; on each Side were the *Reflections* with the *true Sun* in the Middle. Elſewhere, much of the Firmament was of an azure, light-blue Colour. The Circles which I ſaw, were not of *Rainbow* Colours, but *white*. There was alſo, higher in the Firmament, more over our Heads, and toward the South, at the ſame time, at a conſiderable Diſtance from the other, the Form of a Half Moon; but I think it was more than twice the Bigneſs of a Half Moon, with the Horns turned upward, and within of a fiery *Red* Colour, and more like a *Rainbow* Colour; theſe all faded gradually; they continued, in all, I ſuppoſe, two Hours.

In Suffolk; *by M.* Petto, n. 250. p. 107.

6. *Feb.* 26, 169$\frac{8}{9}$. About half an Hour after 3 in the Afternoon, chancing to look out of a Window that faced South-Eaſt, I ſaw not far from the South to the Weſt-ward, an Appearance of ſomewhat not much unlike the *Sun* when ſeen through Clouds, *viz.* with its Periphery not exactly defined: From which it likewiſe differed, in that one half of it was coloured deep *Red* and *Yellow*, the other *White*. I went immediately into the Garden and ſaw an Appearance exactly like the former, but on the oppoſite Side of the *Sun*. The Diſtance of this was 23° from the *Sun* to the Weſtward; but before I could take the Diſtance of the Eaſtern one, it vaniſhed, but

At Canterbury; *by Mr.* St. Gray, n. 251. p. 896.

but ſoon after re-appear'd, and then I perceived manifeſtly, that they were both ſituate in the Extremities of a *Semicircle* (whoſe Center was the *Sun*, paſſing betwixt it and the *Zenith*. This Appearance continued about half an Hour.

At Canterbury; by M. St. Gray, n. 262, p. 535. *Fig.* 31.

7. *Apr.* 7th, 1699. Between 4 and 5 a Clock, there appeared on each Side the *Sun A.* a *Parhelion*, *B C*, connected by an *Halo B D C*, of the uſual Diameter; they had each of them a *Tail* of a *whitiſh* Colour, extended oppoſite to the *Sun*, of about 15 or 20 *Degrees* in Length; the upper Part of the *Halo* was touched at *D*, by the Arch of a Circle, whoſe Ends were turned towards the *Zenith Z*; it had the Colours of the *Iris*, but faintly; betwixt this and the *Zenith* was another Portion of a Circle *E*, which had the Colours of the *Iris* with greater Vivacity than the former.

Rainbows *obſerved in* France; *by* M. Eſtienne, n. 13. p. 221. *Fig.* 32.

LXVI. 1. *An.* 1665. *Aug.* 10. About half an Hour paſt 6 in the Evening, two odd *Rainbows* appeared at *Chartres* in *France*, croſſing one another almoſt at right Angles. The *Rainbow*, which was oppoſite to the *Sun*, in the uſual Manner, was more deeply *colour'd* than that which croſs'd it: and its greateſt Height was about 45 *Degrees*. The feebler *Rainbow* loſt one of its Legs, by growing fainter, about 20 *Degrees* above the ſtronger; and the Leg below appeared continued to the *Horizon*. This ſeem'd to be a Portion of a great Circle; and the ſtronger was but a Portion of a ſmall Circle, as uſually.

The *Sun*, at their Appearance, was about 6 *Degrees* high above the *Horizon*. The River of *Chartres*, which runs very near from South to North, was betwixt M. *Eſtienne* (the Obſerver) and the *Rainbow*, and he ſtood level with the River, whence he was diſtant not above 150 Paces.

At London; *by Mr.* Edm. Halley, n. 240. p. 195.

2. *Mar.* 11th, 1696. It rained pretty thick a ſmall Rain, and the *Sun*, about 2 of the Clock, ſhone directly down *Abchurch-Lane*, as I was paſſing along it with my Back to him, when I perceived the Arch of the *primary Rainbow* in the Drops of Rain, ſpanning the Street like an Arch of a Building, under which I was to paſs, the Crown whereof was not much higher than my Head, and the Diameter thereof ſcarce ſo wide as the Street, which is but 5 Yards; and it moved along with me as faſt as I went; the Colours being very vivid and diſtinct, though the Arch it ſelf appear'd but narrow, and the Houſes were every where behind it. This, tho' very uncommon, will not appear ſtrange to thoſe who have well conſider'd the Nature of the *Iris*.

At Cheſter; *by Mr.* Edm. Halley, n. 240. p. 193.

3 *Aug.* 6th, 1698. Between 6 and 7 a Clock in the Evening, I obſerved an *Iris*, exceedingly vivid, as to its Colours, at firſt on the South-ſide only, but in a little Time with one entire Arch; and ſoon after, the Beams of the *Sun* being very ſtrong, there appear'd a *ſecondary Iris*, whoſe Colours were more than ordinary bright, but inverted, as uſually; that is, the *Red* was inwards, which in the *primary Iris* is outward, and *è contra* for the *Blues*. But what I took moſt notice of was, that with theſe two concentrick Arches, there appear'd a third Arch, near upon as bright as the *ſecondary Iris*, but coloured in the Order of the *Primary*, which took its Riſe from the Interſection of the *Horizon* and *primary Iris*; and went croſs the Space between the two, and inter-

Fig. [illegible]

interſected the *Secondary*, as in the *Figure A F C G* interſects the *ſecondary Iris E F G D*, dividing the Arch *E D* into three equal Parts, as near as I could then gueſs: But at firſt the Arch *A F* did not appear, which afterwards became as bright as the former. I obſerved the Points *F*, and *G*, to ariſe, and the Arch *F G*, gradually to contract, till at length the two Arches *F H G*, and *F G*, became coincident; when, for a great Space, the *ſecondary Iris* loſt its *Colours*, and appear'd like a white Arch at the Top. I obſerved alſo, that at the Points *F*, and *G*, the Interſection of the interior *Red* of the *ſecondary Iris*, and the exterior *Red* of the Arch was much more intenſely red than the outward Limb of the *primary Iris*; and that during the whole Appearance, the upper Part of the *third Iris* was not at all viſible, beyond the Interſections *F G*. This uncommon Sight entertained me for about 20 *Min.* when the Clouds blowing away, the whole vaniſhed. I was at firſt amazed with the Sight, but afterwards, recollecting that the Sun ſhone along the River *Dee*, which, from thence empties it ſelf into the *W. N. W.* where the Sun then was, I concluded this ſecondary Arch *A F H G C*, was produced by the Beams of the Sun reflected from that Water, which at that time was very calm; and it had been much more bright, had it been at that time about high, as it was low Water, when all the Sands were bare. I was ſoon confirmed that my Suppoſition was right, and that it anſwered all the Appearance without any Scruple, and that the Arch *A F H G C*, was no other than that Part of the Circle of the *Iris*, that would have been under the Earth, bent upwards by Reflection.

I remember not to have read of any ſuch *Iris* in any Author. *Des Cartes* indeed ſpeaks of an inverted *Iris* by *Reflection*; but it is not poſſible to be ſeen as he deſcribes it: And I quæry whether ever any ſuch has been really obſerved.

The Cauſes of Halo's *and* Parhelia, *conſider'd, by M.* Hugens, n. 60. p. 1066. *Vide ſuprà*, §. LXIV.

LXVII. The Obſervation of the *Halo*, which appeared at *Paris*, *May* 12, 1667. engaged M. *Hugens* to propoſe to the Academy there, what he had meditated ſome Years before, not only of theſe *Halo's*, but alſo of the *Parhelia*. As for *Halo's*, he ſaid, that they were formed by ſmall and round *Grains* made up of two Parts, one tranſparent, the other opaque; the latter being incloſed in the former, as a Cherry-ſtone is in a Cherry. Thus *A A*, repreſents one of theſe Grains, and *B* the *Kernel* or opaque Part.

Fig. 34.

He related the Obſervations of thoſe who have ſeen *Hail* formed after this Manner, and explain'd how that ſome of theſe little Grains, which ſwim up and down in the Air betwixt us and the Sun, being leſs diſtant from the Axis, which extends it ſelf from the Sun to our Eye, than of a certain Angle, do neceſſarily hinder the Rays, which fall on them, from coming to our Eyes, in Regard that the opaque *Kernel* is the Cauſe that there is behind every ſuch *Grain* a Space of a *Conical Figure*, as *M N O*, in which the Eye of the Spectator being ſituated, cannot ſee the Sun through that Grain, tho' it may ſee him when poſted elſewhere, as ſomewhat in *P*.

Fig. 35.

And to make the Company the more diſtinctly to underſtand the Effect which theſe *Grains* ſuſpended in the Air muſt produce, he drew the 35 *Fig.* in which *B* is the Place of the Eye; *B A*, the *Axis* which paſſeth from the Eye to the Sun: *C, M, F*, ſome of the *Icy Grains* with their Kernel, making them half opaque: Among which the *Grain C*, being in the Axis *B A*, and the Lines *C K*, *L H*, repreſenting the Rays of the *Sun* neareſt to the Axis, the Paſſage of which is not hindred by the Opacity of the *Kernel*, it is certain, not only the *Grain C*, will not be able to tranſmit any Ray of the Sun towards *B*, but alſo that, imagining the Superficies of a Cone, whoſe Top is in the Eye, and its Sides *B D*, *B E*, parallel to the Rays *C K*, *L H*; all the *Grains M M*, which this Superficies ſhall comprize, will likewiſe not ſuffer any Ray to paſs to the Eye, becauſe it muſt needs be in their *Cone* of Obſcurity; but thoſe that ſhall be without this Superficies, as the *Grains F F*, will let them paſs, becauſe the Eye is without their *Cone* of Obſcurity. Whence it follows, that the Angle of this *Cone B D E*, is that which determines the Diameter of the *Halo*, which depends from the Proportion the opaque *Grain* hath to the tranſparent, in which it is incloſed. For if this Diameter is of 44 *Degrees*, as is obſerved in moſt *Halo*'s, the Bigneſs of the opaque *Grain* will be to the tranſparent, as 40 to 19. But he ſaid, that this Proportion was not always the ſame, and that the Diverſity of it was the Cauſe, that ſometimes there were ſeen many *Halo*'s, one about the other, all having the Sun for their Center.

He added, That it was eaſy to know, why theſe *Halo's* were always of a round Figure, whether the Sun be little or much raiſed above the Horizon; as alſo to give a Reaſon of their Colours, which is the ſame with that in the triangular Glaſs *Priſms*; as is evident by the *Tangents A, C*, drawn to the *Grain A*, at the Points, where the *Ray D A* enters or comes out.

Farther, he took notice, That it was alſo manifeſt why the Red Colour is in the interior Circumference of the *Halo*, and why the Space, which it taketh in, and chiefly near the moſt lively colour'd Parts, appears obſcurer than the Air about; *viz.* becauſe it is there, where moſt Grains are, which tranſmit no Rays of the *Sun* to our Eyes, and ſo do nothing but darken the Air, as the Drops of Water when it raineth.

Fig. 36.

As to the *Arch* of the *Circle*, which above touched the *Halo*, ſeen *May* 12, 1667, as alſo that the Colours were more vivid in this Place, and in that below, that in the reſt of the Circle; he ſaid, that theſe Effects did not proceed from the Grains he had been ſpeaking of, but from another Cauſe, which did alſo ſerve for the Production of the *Parbelia*, and the *Circles* which almoſt always accompany them. Touching which *Circles* and *Parbelia's*, he told the Company, that beſides the round and half dark Grains, there were alſo formed in the Air certain little *Cylinders* of the like Nature: Which being ſuppos'd to be oblong Icy Grains, and roundiſh at both Ends, having the inner Kernel of the ſame Shape, it was found, that from their different Diſpoſitions all the Appearances of the *Parbelia* and their *Circles* did neceſſarily follow.

And firſt, That ſome of theſe *Cylinders* being erect, in the Situation which probably he ought to have in being formed there, muſt appear in the Heavens a great *white Circle*, parallel to the Horizon, paſſing thro' the Sun, and of near the ſame Breadth with him; as hath been obſerved in the *Phænome-*

non of *Rome*, *An.* 1629. of which *Gaſſendus* and *Des Cartes* have written, and which is here exhibited.

That this *Circle L K N M*, is cauſed by the *Reflection* of the Rays of the *Sun* upon the Surface of theſe *Cylinders*, it being eaſy to demonſtrate, that there are none but thoſe which are raiſed at the ſame *Angle* above the *Horizon* with that of the Height of the *Sun*, that can reflect his Rays to our Eyes: Whence it manifeſtly follows, that it muſt appear *white*, and throughout of equal Altitude with the *Sun* it ſelf, and by Conſequence parallel to the *Horizon*. That conſidering afterwards the Tranſparency of theſe perpendicular *Cylinders*, and their opaque *Kernels*, it is eaſily ſeen, that thoſe of the *white Circle*, which are diſtant from the *Sun* at a certain *Angle*, begin to give Paſſage to his *Rays* to ſtrike our Eyes in the ſame Manner as hath been ſaid of the round half dark *Grains*: That theſe *Cylinders* are thoſe, which on each Side of the *Sun* make us ſee a *Parhelion* in the great *white Circle*, as hath been noted in the Obſervation of *Rome* where they are mark'd with *K* and *N*, and in many others. That theſe *Parhelia* have commonly luminous *Tails*, becauſe the *Cylinders*, which follow thoſe firſt ones that form the *Parhelia*, and which are yet farther diſtant from the *Sun*, let alſo paſs his Rays to our Eye; ſo that theſe *Tails* may be 20 *Degrees* and more in Length. That the ſame *Parhelia* are always colour'd, becauſe they are made by *Refraction* as the *Halo*. Fig. 37.

That beſides, there are two other Images of the *Sun* generated by theſe perpendicular *Cylinders*, and ſo diſpoſed in the great *white Circle*, that the Spectator turning his Face towards the *true Sun*, hath them behind him; as in the *Roman* Obſervation are the *Parhelia L* and *M*. That theſe are produced by two *Refractions* and one *Reflection* in theſe *Cylinders*, in the ſame Manner as the ordinary *Rainbow* in the Drops of Water, according as M. *Des Cartes* hath declared: So that the *opaque Kernels* do nothing to the Production of theſe two *Suns*, but that they may be ſometimes ſo big as to make them not appear. That according to the *Altitude* of the *Sun*, more or leſs, theſe two *Parhelia* are more or leſs nigh to one another. That they ſhould appear colour'd as the *Rainbow*, and that ſometimes they have been ſeen ſuch; but that when they are faint, they may alſo ſeem white, even as the *Halo's* when they are not very bright.

That theſe ſame perpendicular *Cylinders* can alſo produce an *Halo* about the *Sun*, by reaſon of the rounding of their two Ends; which maketh, that being diſtant from the Sun at a certain Angle, on what Side ſoever it be, they begin from thence to give Paſſage to the Rays, tranſmitting them to the Eyes of the Spectator.

And that theſe *Halo's* are probably thoſe, we ſee almoſt always paſs thro' the two *Parhelia* that are on the Sides of the *true Sun*, as the *Halo G K N I*, in the Phænomenon of *Rome*.

That there is yet another Situation of theſe *Cylinders* very conſiderable, which is of thoſe that are couchant, ſo as their Axis are Parallel to the Plane of the *Horizon*, but turned divers Ways, ſome one, ſome another Way, like Needles confuſedly thrown on the Ground: Which *Horizontal* Diſpoſition is very natural to thoſe *Cylindrick* Bodies ſupported by the Vapours, which riſe from the Earth, as may be made out experimentally in Bodies thus figur'd, being let fall in the Air.

That it is in theſe *Cylinders* that the Arches which touch the *Halo's* above or below, are formed; ſuch as there were in the *Phænomenon* obſerv'd at *Rome A.* 1630. which is deſcribed by *P. Shenir*, in a Letter to M. *Gaſſendus*; as alſo in all thoſe which M. *Hevelius* had related at the End of his *Mercurius in Sole*.

And that the *Arch*, which appeared upon the laſt *Halo* at *Paris*, *A.* 1667. was of the ſame Kind. That the Figure of theſe *Arches* is different according to the different Altitudes of the *Sun*, and the ſeveral Magnitudes of the Diameters of the *Halo's*.

That when the *Sun* is very nigh the *Horizon*, ſuch an *Arch* appearing upon an ordinary *Halo* of 44 *Degrees*, muſt repreſent, as 'twere, two *Horns*, as in *Fig.*
Fig. 38. 38. *A B*, *A C*. But that the *Sun* riſing higher, thoſe *Horns* become lower in Proportion, and make ſuch Arches as are repreſented in the ſame *Fig.* where each Height of the *Sun* is mark'd near the *Arch* which it is to make.

That the Place of the *Arches* where they touch the *Halo's* being more ſtrongly enlightned and colour'd than the reſt, maketh us judge that there are *Parhelia* in thoſe Places. That the Reaſon why theſe *Arches* do ordinarily touch a *Parhelion*, was, that the ſame *Cylinders couchant*, which produce the Arch, produce alſo that *Parhelion*, by the Means of their two round and tranſparent Ends, in the ſame Manner as hath been ſaid of the *perpendicular Cylinders*. And that the *Parhelion* laſt ſeen at *Paris*, had been form'd in theſe *couchant Cylinders*. That that was alſo confirmed, by Reaſon that it was brighter in the ſuperior and inferior Part than any where elſe; which neceſſarily comes to paſs in a *Parhelion* cauſed by *Cylinders* thus diſpoſed; whereas when produced by the *round Grains*, it muſt appear every where equally ſtrong.

That in theſe ſame *Cylinders parallel* to the *Horizon*, there is alſo found the Cauſe of the *white Croſs*, obſerv'd together with the *Paraſelenes* or *Mock-moons*, by M. *Hevelius*, and exhibited at the End of his *Mercurius in Sole*; the perpendicular Fillet of that Croſs coming from the Reflection of the Rays of the Moon upon the Surface of theſe *Cylinders*; as the other Fillet, parallel to the *Horizon*, is produced by the Reflection of the perpendicular *Cylinders*, which make the great white Circle, of which this Fillet is a Part. That yet the Moon muſt not be very high above the Horizon, to the end that the couching *Cylinders* may produce this Effect: And that it ſhould be well heeded, when the like Meteors ſhall appear, whether the perpendicular Fillet be not narrower where it paſſeth through the Moon, that in other Places, and eſpecially upwards, where it muſt grow larger, and diſappear. That beſides the perpendicular *Cylinders*, and thoſe that are couched parallel to the Horizon, there are often a great many, which move to and fro in the Air, in all ſorts of Poſitions; and that thoſe, by the ſame Reaſon that the round Grains do, muſt produce an *Halo* about the *Sun*, and even a more vivid one than that which is cauſed by the Grains, foraſmuch as each *Cylinder* ſends many more Rays to the Eye, than each of theſe little Spheres. That the little *Halo*
Fig. 37. *D E F*, in the *Roman Phænomenon* (*Fig.* 37.) may very well have been cauſed by ſuch *Cylinders*.

As to thoſe *Mock-ſuns*, which ſometimes ſhew themſelves directly oppoſite to the true Sun (ſuch an one as was publiſhed by M. *Hevelius*, and obſerv'd *Feb.* 23, 1661.) that he could find nothing, neither in the round Grains nor in the Cylinders, which ſhould make theſe *Suns* neceſſarily to meet in the great white Circle, parallel to the Horizon; and that if that ſhould be always verified by future Obſervations, the Cauſe of it muſt be look'd for elſewhere: But that in the mean time he did believe, that that happened not but by Chance; which being ſo, a Reaſon might be given of theſe *Suns*, by the ſame Suppoſition, which ſerved alſo for the *Anthelion*, obſerved by M. *Hevelius*, *Sep.* 6, 1661. in which there were two colour'd Arches of a Circle, oppoſite to the *Sun*, which did interſect one another, their Interſection being the Place of the falſe Sun. Which although it be repreſented in the Figure of *Hevelius*, at the ſame Height with the true Sun, yet it was in Truth higher by 15 *Degrees* or more; as he hath acknowledged himſelf afterwards: So that, if there had been a great white Circle in this *Phænomenon*, the *Parhelion* was not at all to have been in it.

That for the Generation of theſe Suns, he did ſuppoſe a Number of ſmall Cylinders with opaque Kernels, as the precedent, which were carried in the Air, neither perpendicularly nor couching, but inclined to the Plane of the Horizon at a certain Angle, being near a half right one; to which were particularly appropriated thoſe Cylinders, which M. *Des Cartes* ſaw fall from the Heavens, having Stars at both Ends; as may be ſeen experimentally by forming Cylinders of that Faſhion, which is repreſented in *Fig.* 39. and letting them deſcend in the Air, or in Water. *Fig.* 39. That in theſe Cylinders was found, the following *Calculus* to be given in another Treatiſe of *Parhelia*'s, not only the Cauſe of the *Anthelia* made by the Interſection of two Arches as in *Fig.* 40. but alſo that of ſome other extraordinary Arches and Rods, *Fig.* 40. that are ſometimes obſerved near the *Sun*, of which notwithſtanding there could nothing be as yet affirmed with Certainty, for want of exact and faithful Obſervations.

To make all theſe different Effects of the Cylinders manifeſt to the Eye, M. *Hugens* produced one of Glaſs, a Foot long, of the Shape of that in *Fig.* 36. *Fig.* 36. and for the Kernel opaque in the middle of a Cylinder of Wood, and in the ambient Space filled with Water inſtead of tranſparent Ice: Which Cylinder being expoſed to the Sun, and the Eye put in ſuch Places as was requiſite, there were ſucceſſively ſeen all thoſe Reflections and Refractions, that have been diſcourſed of. Whence it might be concluded, that a great Number of the like Cylinders, altho' very ſmall in Compariſon to that, being found in e Air, and having the ſeveral Poſtures that have been ſuppoſed, all the Ap-arances of the *Parhelia* and their Circles muſt exactly follow.

It was wiſhed, for an entire Confirmation of the Truth of this *Hypotheſis*, at ſome of thoſe ſmall Cylinders could be obſerved to fall to the Ground, the time when any *Parhelia* do appear: Which yet he ſhewed could not ly be done, becauſe that the Vapours, which then riſe from the Earth wards, and which are the Cauſe of their Cylindrical Figure, keep them ſo ſuſpended in the Air. He added, that it was not to be thought ſtrange, that ſuch ſmall Grains of Hail were thus kept in the Air by the Vapours, for as much as theſe, by being rarified and dilated upwards, might have Motion enough for this Effect; and that that was much more eaſy to conceive, than to imagine how theſe ſame Vapours could keep ſuſpended a very great and weighty Circle of Ice, ſuch as Mr. *Des Cartes* ſuppoſeth to explicate the Cauſe of *Parhelia*'s, and of the great white Circle of the *Roman* Phænomenon.

Optical Aſſertions *concerning the* Rainbow, *by Mr.* Fr. Linus, n. 117. p. 386.

LXVIII. 1. Every the leaſt Drop of Rain, when illuminated by the Beams of the Sun, ſends from it a perfect *Iris*, not only as to the Colours, but alſo exactly like that which we ſee in the Heavens, as to their Order, Situation, and Circular Figure.

2. For the Sun-beams entering the Drop, and returning towards the Sun again after two Refractions and one Reflection, are coloured at their breaking out of the Drop, and with the ſame Colours that we ſee in the Rain-bow; that is, become Red, Yellow, Green, Blue, and Purple.

3. Theſe Rays thus coloured, being tranſmitted to the Eye from a multitude of Drops illuminated by the Sun in a rainy Sky, cauſe that Senſation which we have of the Rainbow.

4. Now in every Drop there are two Rings, a greater and a leſſer, endued with diſtinct Colours of the Iris; the leſſer of which is diſtant from the Axis, or from the Radius paſſing through the Center of the Drop, about 21 Degrees; but the greater is diſtant from the ſame Axis 78 Degrees. Now the Rays that are incident upon the leſſer Ring are reflected from thence upon the greater; from whence breaking forth into the Air, they are imbued with the ſaid Colours of the Iris.

5. Therefore theſe Colours ariſe from the Sun-beams; but not from them alone, as has been hitherto thought, but alſo from the Rays of the Air itſelf, which ſurrounds the Body of the Sun.

6. But neither do theſe Colours ariſe from all the Rays, whether of the Sun or of the Air, which enter into the Drop, but only from thoſe which are emitted by the Limb of the Sun itſelf, and from the Air that is near it.

7. Alſo of thoſe Rays which are thus tranſmitted into the Drop from the Limb of the Sun and the neighbouring Air, not all belong to the ſaid Colours, or break out colour'd; but thoſe only of which the Angle of Incidence is not leſs than 45 Degrees, nor greater than 75 Degrees.

8. Therefore the Colours of the Iris proceed from the Solar Limb and the neighbouring Air, yet all the five do not immediately flow from thence, but four only; that is, the Red, Yellow, Blue, and Purple. For the Green ariſes from the Yellow and Blue Rays mix'd together.

9. Therefore theſe four Colours ariſe from the aforeſaid Limb, yet not all from one and the ſame Part of that Limb; but two of them from one Part of the Limb, and the other two from that Part which is directly oppoſite to it. That is, the Blue and Purple proceed from the upper Limb, and the Red and Yellow from the lower Limb.

10. Now as to the reaſon why ſuch different Colours ariſe from Limbs that are ſo ſimilar to each other, there appears to be no other but this; that

in one caſe the Limb of Air is above the Solar Limb, and in the other the Solar Limb is above that of Air. And this Difference ſeems to be ſufficient here, becauſe in reſpect of that different Situation, ſometimes the Solar Rays are bent by Refraction above the Airy Rays, and ſometimes on the contrary.

11. Therefore theſe Colours ariſe by the ſaid refracted Rays, yet ſo refracted that they are very much condenſed by that Refraction. For all the Rays from 45 to 60 Degrees are contracted into the Space of one Degree in the leſſer Ring. Into which narrow Space alſo are contracted, by Retrogradation, all the Rays from 60 to 75 Degrees.

12. When ſeveral Men ſee a Rainbow at the ſame time, there are ſo many Rainbows ſeen as there are Men to ſee them.

13. He that looks upon a Rainbow, every Moment ſees a different Rainbow.

The Colours *and* Diameter *of the* Rainbow, *from the given* Proportion of Refraction, *and the* contrary. *by Mr.* Edm. Halley, n. 267. p. 714.

LXIX. To thoſe that have carefully conſidered the Phenomena of the Rainbow, it has always been manifeſt, that the Rays of the Sun, reflected by a watry Cloud, have entered the Eye at ſome certain Angle; whence proceeds its Form of a Bow. But the reaſon of its Colours, as alſo of the Magnitude of that Angle, by which we find the Rainbow conſtantly to be diſtant from the Point oppoſite to the Sun, has given much trouble both to the Ancients and Moderns. Nor did they do any thing to the purpoſe, till the famous *Des Cartes*, calling to his Aſſiſtance the Mathematical Sciences, informed us by many Examples, that theſe Phyſical Speculations might and ought to be treated in a ſtricter Method of Argumentation. And among other things he has given us the Theory of the Rainbow. From his Demonſtrations it is plain, that the primary Iris is produced by ſuch Rays of the Sun, in which the Exceſs of the two refracted Angles above the one Angle of Incidence, is the greateſt of all poſſible Angles. That the ſecondary Iris is formed by thoſe Rays only, in which the Exceſs of the three refracted Angles above the one Angle of Incidence, in like manner is the greateſt poſſible. And ſo we might go on to the third, fourth, or any other Iris, which are made when the Rays emerge out of the Drops, after three, or four, or more Reflexions. Now in all theſe there is a general Rule, that the Exceſs of four or five or more refracted Angles, (that is, the Number of Reflexions muſt be increaſed by an Unit,) above one Angle of Incidence, muſt be the greateſt of all. Now that greateſt Exceſs being doubled is always the Diſtance of the Iris from the Point oppoſite to the Sun, when the Number of Reflexions is odd. But if that Number be even, the double of that greateſt Angle is the Diſtance of the Iris from the Sun itſelf.

ow that thoſe greateſt Exceſſes may be had, the Refraction of any Liquid b g given, or the Ratio of the Sine of Incidence to the Sine of the refracted A gle; we muſt take Notice that the Exceſs of two refracted Angles above o Angle of Incidence is then greateſt, when the momentary Augment of the A gle of Incidence is exactly double to the momentary Augment of the refr ted Angle. But of three refracted Angles the Exceſs is then greateſt, when t momentary Augment of the Angle of Incidence is triple to the Moment of t refracted Angle: And ſo of the reſt. And this is manifeſt of itſelf. Now we ſhall obtain the Angles themſelves by premiſing the following Lemma, which we muſt demonſtrate.

Lemma. The Legs of any plain Triangle continuing the ſame, if the Vertical Angle be encreaſed or diminiſhed by any Angle leſs than any given one, the Moments or inſtantaneous Mutations of the Angles at the Baſe, will be to one another reciprocally at the Segments of the Baſe.

Fig. 41. Let *ABC* be a Triangle, whoſe Vertex is *A*, the Legs *AB* and *AC*; and the Baſe *BC*; upon which let fall the Perpendicular *AD*. Then let the Angle *BAC* be encreaſed by any indiviſible Moment *CAc*, and draw the Lines *Bcd* and *cD*, which will differ from the Lines *BCD* and *CD* only intellectually. I ſay the Moment of the Angle *ABC*, that is *CBc*, is to the Moment of the Angle *ACB* or *ACD*, as *CD* to *BD*, that is reciprocally as the Segments of the Baſe. For as the Angle *ACD* is the Sum of the Angles *ABC* and *BAC*, its Moment will alſo be the Sum of the Moments of thoſe Angles, or $CAc + CBc$. But *CAc* is equal to the Angle *CDc*; for becauſe of the right Angle at *D*, the Points *A*, *D*, *C*, *c*, are at the Circumference of a Circle whoſe Diameter is *AC*, by Eucl. 3. 9. And therefore the Sum of the Angles *CBc* and *CDc*, that is the Angle *Dcd*, will be the Moment of the Angle *ACD*, or *ACB*. But the Angles *CBc* and *Dcd*, being indefinitely little, are to one another as their oppoſite Sides, or as *cD* or *CD* to *BD*, that is, reciprocally as the Segments of the Baſe. Q. E. D. Now if either of the Angles *B* or *C* is acute, changing what is to be changed, the Lemma will be demonſtrated as above.

Corol. Hence it follows, that the Moments of the Angles at the Baſe are to one another directly as the Tangents of thoſe Angles.

Fig. 42. By the Help of this Lemma we may eaſily obtain the Diameter of any Rainbow, either by a Geometrical Conſtruction or by Calculation. For aſſuming any right Line *CA*, firſt let it be divided in *D*, ſo that *CA* may be to *CD* in the Ratio of Refraction, which in Water is as 250 to 187, or more accurately *Fig.* 42. as 529 to 396. Then let *CA* be divided in *E*, ſo that *CE* may be to *AE*, as Unity is to the Number of Reflexions which a Ray of the Sun ſuffers, proper to produce the propoſed Rainbow. Then with the Diameter *AE* let the Semicircle *ABE* be deſcribed, and with Center *C* and Radius *CD* draw the Arch *BD*, meeting the Semicircle *ABE* in the Point *B*. Laſtly, drawing the right Lines *CB* and *AB*, upon *AB* produced let fall the Perpendicular *CF*, and *EB* Parallel to it. I ſay the Angle *CBF* will be the Angle of Incidence, and *CAB* the refracted Angle, as were required; and theſe will produce the propoſed Rainbow.

Demonſtration. Since the Triangles *ACF* and *AEB* are ſimilar, it will be *AF* to *BF*, ſo is *AC* to *EC*, that is, as the Number of Reflexions encreaſed by Unity is to Unity, by the Conſtruction. Therefore the Moment of the Angle *CBF* will be to the Moment of the Angle *CAF* in the ſame Proportion; by the foregoing Lemma. But the Sine of the Angle *CBF* is to the Sine of the Angle *CAF* in the Ratio of the Sides *CA* and *CB*, that is, the Ratio of the given Refraction, alſo by Conſtruction. Therefore the Angle of Incidence *CBF* has its correſponding refracted Angle *CAF*, and their Moments are in the Ratio propoſed; therefore they are the Angles required. Q. E. D. And now multiplying the refracted Angle by the Number of Reflexions encreaſed by Unity, and from the Product ſubtracting the Angle of Incidence, we ſhall have half the Diſtance of the Rainbow from the Sun, if the Number of the Reflexions is even, or from the Point oppoſite to the Sun if odd, as ſaid before.

Hence by a Conſtruction that is neat enough and not inelegant, we may exhibit by Way of Synopſis the Incidences of all Rainbows in order, in any Liquid, the Refraction of which is known. For if the aſſumed Line AC is divided in two equal Parts at E, in three at e, in four at ε, in five at η, and ſo on; and with the Diameters AE, Ae, $A\varepsilon$, $A\eta$, &c. are deſcribed the Semicircles ABE, Abe, $A\beta\varepsilon$, $A\upsilon\eta$, all which are met by the Circular Arch $DBb\beta\upsilon$; deſcribed with Center C and Radius CD, (which Radius is to AC in the given Ratio of Refraction,) in the Points B, b, β, υ; I ſay that drawing the Lines AB, Ab, $A\beta$, $A\upsilon$, they will conſtitute with the Line AC the Angles CAB, CAb, $CA\beta$, $CA\upsilon$, equal to the refracted Angles; and with the Rays CB, Cb, $C\beta$, $C\upsilon$, reſpectively, Angles equal to the Angles of Incidence required. That is, ABC, or rather its Compliment to a Semicircle for the primary Rainbow, AbC for the ſecondary, $A\beta B$ for the third, and $A\upsilon C$ for the fourth; and ſo on.

Now if any one is deſirous to inveſtigate theſe Angles by an exact Calculation, from the ſame Source an Analyſt will eaſily diſcover, that making Radius $= 1$, and the Ratio of Refraction as r to s, the Sine of Incidence will be $\sqrt{\frac{4-1rr}{3-3ss}}$; but the Sine of the refracted Angle will be $\sqrt{\frac{4ss-1}{3rr-3}}$, from which Angles the primary Rainbow proceeds. But for the ſecondary $\sqrt{\frac{9-1rr}{8-8ss}}$ will be the Sine of Incidence, and $\sqrt{\frac{9ss-1}{8rr-8}}$ the Sine of the refracted Angle. For the third, the Sine of Incidence will be $\sqrt{\frac{16-1rr}{15-15ss}}$, and the Sine of the refracted Angle will be $\sqrt{\frac{16ss-1}{15rr-15}}$. For the fourth the Sine of Incidence will be $\sqrt{\frac{25-1rr}{24-24ss}}$, and the Sine of the refracted Angle $\sqrt{\frac{25ss-1}{24rr-24}}$. And ſo of the reſt. Admitting the Ratio of *Des Cartes* you will find by Calculation, that the primary Rainbow is diſtant from the Point oppoſite to the Sun 41°. 30′. The ſecundary 55°. 55′. The third 40°. 20′. and the fourth 45°. 33′. from the Sun itſelf. Theſe laſt I know not whether any one will be able to ſee, becauſe of the Light of the Sun growing more and more feeble in every Reflexion and Refraction. And this may ſuffice concerning the Magnitude of the Rainbow in the tranſparent Drops of a Fluid, whoſe refractive Power is known. We muſt now add ſomething concerning the Colours with which the Rainbows are painted, and their Order in each; being varied by the Refraction through all poſſible Degrees.

Firſt it muſt be known, that all Light of the blue kind is refracted ſomething more than any red Light; from which Difference ariſes the Breadth of the Rainbows, which is hardly to be determined by Obſervation, becauſe of the uncertain Limits of the Colours in the Cloud. But the greater is the Ratio of Inequality between CA and CD, or the greater the Refraction is, ſo much the greater is the Diſtance of any Rainbow from the Sun, and therefore the Limits of Rainbows that are more remote from the Sun always ſhine with purple Colour, and the nearer are intenſely ruddy. This may always be ſeen in the primary Iris, which vaniſhes oppoſite to the Sun, if the Sine of Incidence is to the Sine of the Angle of Refraction, as *CA* to *CE*, or as 2 to 1. If that Ratio be greater, no primary Rainbow can be ſeen at all.

But it is to be obſerved, that the ſecundary Iris goes off in a Point oppoſite to the Sun, whenever the Ratio of Refraction is, as 1 to 0,847487... Thence it returns to the Sun itſelf, and there vaniſhes, if the ſaid Ratio is, as 3 to 1, or as *CA* to *Ce*. But in intermediate Ratios, ſuch as obtain in all known Fluids except Air, the greater the Ratio is, ſo much the more the Iris is diſtant from the oppoſite Place of the Sun, or rather from the Sun itſelf, reckoning the Arch beyond the Semicircle. And therefore the Colours will be found in an inverted Order from the Primary, in theſe returns, unleſs the Diſtance of the Iris from the Sun is taken in this Senſe. And this is to be obſerved every where in the reſt.

The third Rainbow is loſt in Oppoſition to the Sun, when the Ratio of Refraction is, as 1 to 0,91855... And thence recurs to the Sun in the Ratio of 1 to 0,6825... Whence again, the Order of the Colours being reſtored, in the Ratio of 4 to 1, or of *CA* to *Cε*, it ceaſes oppoſite to the Sun. But the fourth Iris beginning from the Sun in the Ratio of Equality, paſſes over in Oppoſition to it in the Ratio of 1 to 0,94895... and thence returns to the Sun, if the Ratio be as 5 to 4. Hence again it is ſpread to the Sun's Oppoſition, in the Ratio of 1 to 0,56337... And in this Space are included the known Refractions of all Fluids. Laſtly, the Ratio being as 5 to 1, or as *CA* to *Cη*, it vaniſhes in the Sun itſelf: The Colours being every where inverted as to Sight in the return to the Sun, but direct in the Egreſs from it. Hence in watry Clouds, the primary and fourth Iris object their ſcarlet Colours to the Sun, but the ſecundary and third their Purple.

But whence the different refractive Virtue of Fluids ariſes, is a Problem of no ſmall Difficulty, and may very juſtly be reckoned among the Secrets of Nature, not yet diſcovered by our Senſes or our Argumentation. For among Fluids pure Water is found to refract the Rays of Light leaſt of all. But imbued by any Salts diſſolved in it, the Refraction is increaſed according to the Quantity of the Salts and its own Weight. And corroſive Spirits, which are much heavier than Water, turn aſide the Rays of Light much more. Nor is it a wonder ſince they are denſer Bodies, and therefore may be conceived the more to obſtruct the Paſſage of Light. But it does not appear by a like Argument, why ſo great a Refraction is found in any ardent Spirits or Oils, eſpecially in Spirit of Turpentine or Wine, ſince they are very light Fluids in reſpect of Water, and conſiſt much of ethereal Particles. This ſeems to require a very intimate Knowledge of the Nature of Light, as alſo of Matter.

Now from the given Diſtance of the Iris from the Sun, to deduce the Ratio of Refraction, ſupplies the Curious with an Occaſion of obſerving very accurately, and with little Trouble, the Refraction of any Fluid whatever. For if a Drop of any tranſparent Fluid hangs at the lower Part of a ſmall Glaſs Tube, and the Sun being near the Horizon, but ſhining clearly, it be obſerved under what Angle with the oppoſite Place to the Sun the Colours of the Iris are ſeen in the Drop; the Ratio required may be had by a little Calculation. The Equation ariſing is Cubick, explicable but by one Root, by which the Ratio is computed from having the primary Iris given. The Equation is $T^3 - 3TTt \ldots 4rrt = 0$, where T is the Tangent of the Angle of Incidence required, and t the Tangent of half the Diſtance of the Iris from the Point oppoſite to the Sun, to Radius $r = 1$. Whence according to *Cardan*'s Rules ariſes this Theorem. From the Cube of t ſubtract the Product of $2tr$ into the Exceſs of the Secant of the ſame Arch above the Radius; the Difference will be a leſſer Cube. And the Sum of the ſame, adding $4trr$, will be a greater Cube. The Sum of the Sides of each Cube, and of t, will be equal to the Tangent of the Angle of Incidence, half of which will be alſo the Tangent of the Angle of Refraction; whence ariſes the Ratio required.

Of this take the following Example. In a Drop of Oil of Turpentine the Diſtance of the primary Iris from the Point oppoſite to the Sun is obſerved to be 25°. 40′. The Ratio of Refraction is required.

$t =$ Tang. 12°. 50′. $=$ 0, 2278063
$s =$ Secant of the ſame $=$ 1, 0256197

$ttt =$ 0,01182217
$s - r$ in $2tr =$ 0,01167265

Difference, or leſſer Cube $=$ 0,00014952. $\sqrt[3]{}$0,0530773

Sum 0,02349482
$4trr$ 0,91122525

Greater Cube 0,93472007. $\sqrt[3]{}$0,9777486
$t =$ 0,2278063

$T =$ Tang. Incid. 51°. 32′ 1,2586322
$\frac{1}{2}T =$ Tang. Refract. 52°. 11′ 0,6293161

Finally, as $\sqrt{TT+4}$, is to $\sqrt{TT+1}$, ſo is r to s, ſo is 1 to 0,68026. And this Ratio approaches nearly to that, which we find by Experiment obtains in Glaſs, and moſt other pellucid Solids. But a Diamond does not only e eed all other diaphanous Bodies in Hardneſs and Value, but alſo in this re-f ctive Virtue; its Ratio being nearly as 5 to 2, or more truly, as 100 to 41. I t of theſe perhaps more at large in a proper Place.

While I was employed in writing this, the very skilful Geometrician, Mr. a *Moivre*, at my Requeſt, took the Pains to find a like Equation for the Ra-t of the ſecundary Iris, when the Diameter is given. By this the Ratio may t determined very accurately, but the Equation being Biquadratick, the Cal-c lation cannot be performed with the ſame eaſe. The Equation is $T^4 + \frac{2}{3}T^3t -$

$T^3t - 2TTrr - \frac{1}{3}r^4 = 0$. Here T is the Tangent of the Angle of Refraction, t the Tangent of half the Diſtance of the Rainbow from the Point oppoſite to the Sun, and the Radius $r = 1$. Now this Equation is of ſuch a Form, as always to be explicable by one affirmative and one negative Root, one of which being the leſſer is the Tangent of the Angle of Refraction in the Regreſs to the Sun, that is, when the Purple Colours are the nearer to the Sun. But the greater Root is the Tangent of the Angle of Refraction, in the Iris going from the Sun, as we have obſerved above, that is in a Fluid of leſſer Ratio. In Oil of Turpentine the Diſtance of this Iris from the Point oppoſite to the Sun is obſerved to be 81°. 30′. Whence the curious Reader may derive the Roots 0,80822... and — 2,98131... the Tangents of the refracted Angles. Hence is computed the Ratio of greater Inequality, as 1 to 0,67995... Such it is in Oil of Turpentine. But from the greater Root proceeds the leſſer Ratio, as 1 to 0,9540... nearly. Such it would be in a Fluid exhibiting the ſecundary Iris of the ſame Diameter, but which would look towards the Sun with its red Colours, after the manner of a primary Rainbow.

A ſtrange Appearance *near* Upſal; By *Dr.* And. Spole, *Ph. Col.* n. 5. p. 146.

LXX. In the Year 1679, in *May*, near the City *Jounkoping*, on a certain Hill that is pretty high, under which at the Diſtance of a Quarter of a Mile lies a Lake of freſh Water, called *Vetter*. On the Surface of this, which was then very calm, and not agitated by a Breath of Wind, the Iſland *Wiſingsburg* ſituate in that Lake was repreſented to me in ſo lively a manner, that it could not have been better drawn by the moſt ſkilful Painter. For I could diſcern the Windows, and Men, and Women, tho' the Iſland itſelf did not yet come into my View, becauſe of the Hills intervening, and was diſtant from me at leaſt three Miles and a Quarter, where ten *Swediſh* Miles make almoſt one Degree. At that time the Sun was juſt riſen, and my Eye was between that Place in the Lake, where theſe Things were repreſented, and the Sun. When I departed from this Place, I could ſee no ſuch Thing in the Lake, as alſo another Day when I came again to the ſame Place at the ſame time. Nothing like it appeared, nor was the Lake ſo calm.

An unuſual Meteor; *by Dr.* Wallis, n. 135. p. 368.

LXXI. *Sept.* 20, 1676, about 7 of the Clock at Night, or ſoon after, there appeared a ſudden *Light*, equal to that of Noon-day; ſo that the ſmalleſt Pin or Straw might be ſeen lying on the Ground. And above in the Air, was ſeen (at no great Diſtance as was ſuppoſed) a long Appearance as of *Fire*; like a long Arm (for ſo it was deſcribed to me) with a great Knob at the End of it, ſhooting along very ſwiftly: And at its diſappearing, ſeemed to break into ſmall Sparks or Parcels of *Fire*, like as *Rockets* and ſuch *Artificial Fire-works* in the Air are wont to do. 'Twas ſo ſurprizing, and of ſo ſhort Continuance, that it was ſcarce ſeen by any who did not then happen to be abroad. I am told by ſome, that it ſcarce continued longer than while one might tell 15 or 20 at the moſt; which will be leſs than half a Minute. All this might happen well enough from ſome *fiery Meteor* in our Air; as a *Draco Volans* (as ſome have been pleaſed to call this) or the like. But that which makes it the more ſurpriſing to me is this, that I find the ſame to have been ſeen in moſt Parts of *England*, and at or near the ſame time: As, not only at *Oxford* and in *Oxfordſhire*, but alſo in *Northamptonſhire*, *Glou-*

ceſterſhire, *Worceſterſhire*, *Somerſetſhire*, *Devonſhire*, *Hampſhire*, *Suſſex*, *Surrey*; *Kent*, *Eſſex*, and particularly by the Watermen on the *Thames*, in their Paſſage between *Graveſend* and *London*.

This is a great Breadth of Ground, and too much for any ordinary *Meteor*, in our lower Region of the Air, to be ſeen in at once; which argues, that either it was higher than it was imagined to be, (though the Light of it reached the Earth,) or elſe, that it had a very ſwift Motion. This made me then conjecture, that it might be ſome ſmall Comet, whoſe *Linea Trajectoria* paſſed very near our Earth, or upon it; and might, when farther diſtant from us, appear as a Comet. And that Comet which hath ſince appeared in *April* and *May* confirms me in the ſame Opinion; which I conjecture may be the very ſame which paſſed by us in *September* laſt. Why it was not ſooner ſeen, I cannot tell; ſave what is the common Fate of moſt Comets, that they are ſeldom obſerved till after their neareſt Diſtance from us: And, perhaps, it may have been ſo near the Sun (as to its viſible Place) as not to be much above our *Horizon*, ſave in the Day time: And for the like reaſon it may be, that in *September* laſt, when it paſſed by us, it was not more ſeen abroad in other Parts: it might paſs them in the Day time, being but in the Twy-light with us, and, had it been one Hour ſooner, the Day-light would have hindered us from ſeeing it. Which way its Motion was when near us, I cannot conclude, ſo as to ſatisfy my ſelf. For moſt that ſaw it being ſuddenly ſurprized, took little more notice of it, than that it ſuddenly appeared, and was ſuddenly gone, but ſaw it ſo little time as ſcarce to mark which way. By the Account I had from one in *Northamptonſhire* (between *Brackley* and *Banbury*) it ſhould ſeem to have moved there towards the South-weſt. By the Account I had from one who ſaw it in *Hampſhire* (between *Wincheſter* and *Southampton*) it ſhould ſeem to be towards the South-eaſt; from others I have nothing of Certainty, and therefore can conclude nothing. Its Motion might then ſeem to us the ſwifter, if its proper Motion were then one Way, and the Earth's Motion here, at the ſame time, contrary to it. And it is not impoſſible that its daſhing againſt the Earth might diſturb its Motion; as when Clouds in their Paſſage meet with Mountains.

The Compreſſion of Air under Water, by Mr. ----n. 73. p 2192.

LXXII. 1. Some Members of the *R. Society* did, with two different ſorts of Inſtruments, make divers Experiments for finding the Proportions of the Compreſſion of Air under Water, in the Month of *July* at *Sheerneſs*, in the Mouth of the River *Medway*, at the time of high Water, where the Depth was then about 19 Fathom; and the Proportion of the Weight of the *Salt-water* to that of the ſame Quantity of freſh Water taken out of the River *Thames*, was as 41 to 42.

One of the Inſtruments was a Glaſs-Bottle that held a Quart of Water, having a braſs Ring faſtened to the Mouth of it, with a *Valve* or Flap that opened inward, ſo well fitted, that the Bottle being filled more or leſs with Water, none dropped out tho' forcibly ſhaken. This let down only 33 Foot into the Water, the Mouth downwards, and after a little Stay drawn up, was found to be ſo very near half full of Water, at ſeveral Trials, that it was thought fit to ſtate the Compreſſion of Air at that Depth to that Meaſure.

The Quantity of *Compreſſion* was known by weighing the Bottle with the Water in it, after that a forcible Depreſſion of the Flap had made way for the Eruption of the compreſt Air (which kept it up even when the Bottle was placed with the Mouth upwards,) and then filling the Bottle full of the ſame Water, and weighing it again; and laſtly, by weighing the Bottle after the Water was all let forth; the Weight whereof being deducted, the firſt Quantity of Water weighed juſt half as much as the ſecond, or ſo near it that the Fraction was not conſiderable. Whence it was concluded, that the Quantity of the Air that filled the Bottle before it was immerſed in the Water, was at the Depth of 33 Feet compreſſed into half the Space it took up before, and ſo proportionable at other Depths.

The other Inſtrument was a Cylinder of Glaſs, ſome 2 Foot long, cloſe at one End, and having the other End drawn ſmall with a Lamp, and turn'd down a little way, after the Manner expreſſed in the *Figure*. *Fig.* 43. This Cylinder was immerſed perpendicularly with the crooked End uppermoſt, by which, as it ſunk in the Water, the Preſſure thereof did gradually force in ſo much Water as compreſt the Air proportionably to every Depth, till the Cylinder was ſo far immerſed, that the Hole in the crooked Part of it was juſt 33 Feet under Water; and then it being drawn up, by meaſuring from the Bottom of the Cylinder to the Height of the Hole in the crooked Part, by a Pair of Compaſſes, the Water was found to fill the Cylinder ſo near the half, that the Motion of the Superfice of the Water, and the Minuteneſs of the Difference being conſidered, it was thought fit to ſtate it to juſt half.

According to theſe Experiments, confirmed by Trials at other Depths, the enſuing Table was computed.

The Proportion of the Weight of Salt Water to that of Freſh, was found by weighing ſome Ounces of both in a Bottle, whereof the Weight was exactly known, and which was made with ſo ſmall a Neck, that the Addition or Diminution of one ſingle Drop in it was diſcernible.

n.5.p.2240. The Table is on theſe Grounds computed, upon the ſuppoſed Depths from the Surface of the Water to the Bottom of the Air included in a Cylinder of 60 Inches, cloſed at one End, and having the open End downwards.

Depths in Water.		*Air compreſt, to*		*Depths in Water.*		*Air compreſt, to*	
Feet.	*Fathoms.*	*Parts.*	*Inches.*	*Feet.*	*Fathoms.*	*Parts.*	*Inches.*
00	00	1	60	7	0	33/40	49 1/2
1	0	33/34	58 4/17	8	0	33/41	48 12/41
2	0	33/35	56 4/7	8¼	0	4/5	48
3	½	33/36	55	9	1½	33/42	47 1/7
4	0	33/37	53 19/37	10	0	33/43	46 2/43
5	0	33/38	52 2/19	11	0	33/44	45
6	1	33/39	50 10/13	12	2	33/45	44

Depths

Depths in Water.		*Air compreſt, to*		*Depths in Water.*		*Air compreſt, to*	
Feet.	*Fathoms.*	*Parts.*	*Inhces.*	*Feet.*	*Fathoms.*	*Parts.*	*Inches.*
13	0	33/46	43 1/23	660	110	1/21	2 6/7
14	0	33/47	42 6/47	693	115½	1/22	2 8/11
15	2½	33/48	41 1/4	726	121	1/23	2 14/23
16	0	33/49	40 20/49	759	126½	1/24	2 1/2
16½	0	2/3	40	792	132	1/25	2 2/5
17	0	33/50	39 3/5	825	137½	1/26	2 4/13
18	3	33/51	38 42/51	858	143	1/27	2 2/9
19	0	33/52	38 1/13	891	148½	1/28	2 1/7
20	0	33/53	37 19/53	924	154	1/29	2 2/29
21	3½	33/54	36 2/3	957	159½	1/30	2
22	0	33/55	36	990	165	1/31	1 29/31
23	0	33/56	35 5/14	1023	170½	1/32	1 14/16
24	4	33/57	34 42/57	1056	176	1/33	1 9/11
25	0	33/58	34 4/29	1089	181½	1/34	1 13/17
26	0	33/59	33 33/59	1122	187	1/35	1 5/7
27	4½	33/60	33	1155	192½	1/36	1 2/3
28	0	33/61	32 28/61	1188	198	1/37	1 23/37
29	0	33/62	31 29/31	1221	203½	1/38	1 11/19
30	5	33/63	31 3/7	1254	209	1/39	1 7/13
31	0	33/64	30 15/16	1287	214½	1/40	1 1/2
32	0	33/65	30 30/65	1320	220	1/41	1 19/41
33	5½	1/2	30	1353	225½	1/42	1 1/7
66	11	1/3	20	1386	231	1/43	1 17/43
99	16½	1/4	15	1419	236½	1/44	1 4/11
132	22	1/5	12	1452	242	1/45	1 1/3
165	27½	1/6	10	1485	247½	1/46	1 7/23
198	33	1/7	8 4/7	1518	253	1/47	1 13/47
231	38½	1/8	7 1/2	1551	258½	1/48	1 1/4
264	44	1/9	6 4/6	1584	264	1/49	1 11/49
297	49½	1/10	6	1617	269½	1/50	1 1/5
339	55	1/11	5 5/11	1650	275	1/51	1 9/51
363	60½	1/12	5	1683	280½	1/52	1 8/52
396	66	1/13	4 8/13	1716	286	1/53	1 7/53
429	71½	1/14	4 1/2	1749	291½	1/54	1 1/9
462	77	1/15	4	1782	297	1/55	1 1/11
495	82½	1/16	3 3/4	1815	302½	1/56	1 1/14
528	88	1/17	3 9/17	1848	308	1/57	1 1/19
561	93½	1/18	3 1/3	1881	313½	1/58	1 1/29
594	99	1/19	3 3/19	1914	319	1/59	1 1/59
627	104½	1/20	3	1947	324½	1/60	1

The Calculation by M-- n. 75. p. 2239 Fig. 44.

2. Let ED repreſent the *Tube* $= x$.

AB, the Diſtance of the upper Part of the *Tube* from the Surface of the Water, above or under it $= b$.

FC, the Depth of the Water from its Surface to the Bottom of the Air within the *Tube* $= a$.

CB, that Part of it which remains filled with Air, within the Water.

CD, the reſt thereof, which is full of Water.

And any two of the three firſt, x, b, and a, being given, the other is known; and conſequently the reſt alſo.

For, if by the incumbent Weight of 33 Feet Depth in Water, the Air in the *Tube* is compreſt into Half the Space it filled before, then the ſaid 33 Feet Depth of Water equals the Weight, or *Preſſure* of the incumbent Air on the Surface of the Water. Now, as the Weight or *Preſſure* of the Air on the Surface of the Water, is to the Depth of the Water, from the Surface thereof to the Bottom of the Air within the *Tube*; ſo is the Length of the *Tube* fill'd with Air, to the Length thereof filled with Water: That is, according to the ſaid Experiments, putting z for 33, or whatever, at other Times or Places, ſhall be found to be the Weight or *Preſſure* of the Incumbent Air on the Surface of the Water (for it is not always the ſame exactly;) $z : a :: a+b : \frac{a^2+ab}{z} = CD$.

And therefore $\frac{a^2+ab+za+zb}{z} = x$.

Wherefore $\frac{z}{z+a}x - a = b$.

And $bb+zb+zz+zx+b - z = a$.

Therefore a and b being given, x is known by the *firſt Equation*; and a and x being given, b is known by the *ſecond*; and b and x being given, a is known by the *third*.

The Horizontal Line $BFBAF$, is ſubſtituted for $GABEFb$, when the *Cloſe* End of the *Tube* is not even with the Surface of the *Water*, to void the Breach $cC = b\ B = \frac{1}{4}x\,b^2$, in the Length of the *Tube*.

Effects of the varying Weight *of the* Atmoſphere *upon Bodies in* Water; *By Mr.* Rob. Boyle, n. 91. p. 5156.

LXXIII. I cauſed to be blown at the Flame of a Lamp three ſmall round Glaſs-Bubbles about the Bigneſs of Hazel-nuts, and furniſhed each of them with a ſhort and ſlender *Stem*, by whoſe means they were ſo nicely *poiſed* in *Water*, that a very ſmall Change of Weight would make them either emerge if they but lightly leaned on the Bottom of the Veſſel, or ſink, if they floated on the Top of the Water. This being done at a time when the *Atmoſphere* was of a convenient Weight, I put them in a wide-mouth'd Glaſs furniſhed with common Water, and leaving them in a quiet Place, where yet they were frequently in my Eye, and were ſuffered to continue many Weeks (or ſome Months) I obſerved, as I expected, that ſometimes they

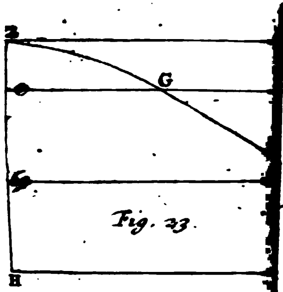


Fig. 23.

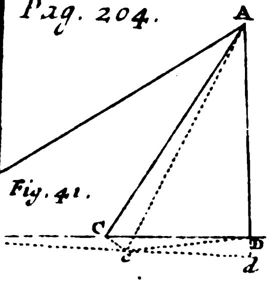


Fig. 41.

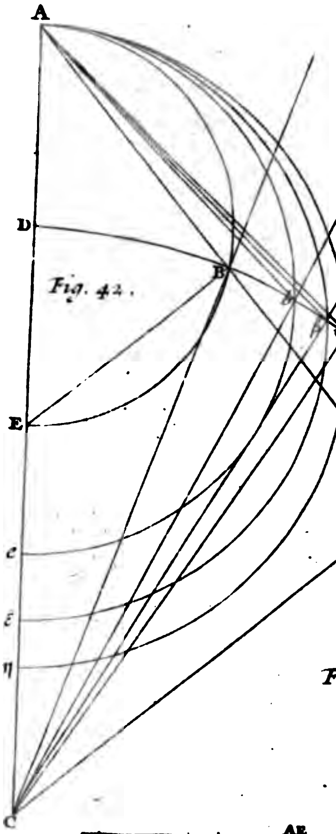


Fig. 42.

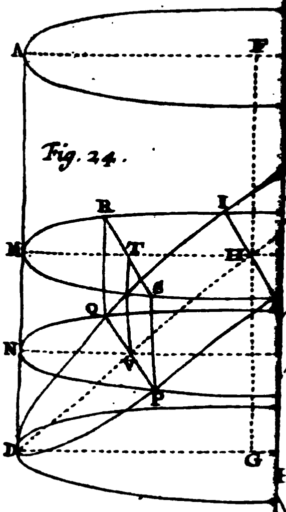
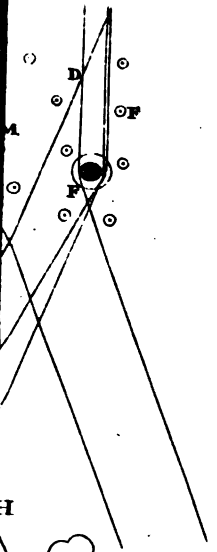


Fig. 24.



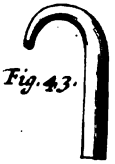


Fig. 43.

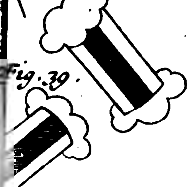


Fig. 39.

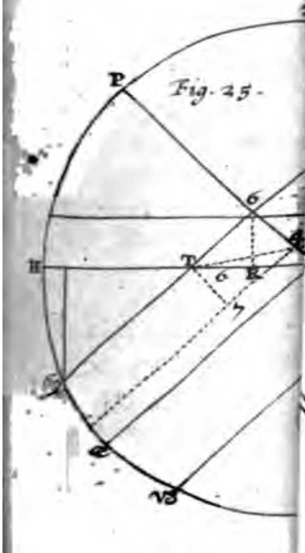


Fig. 25.

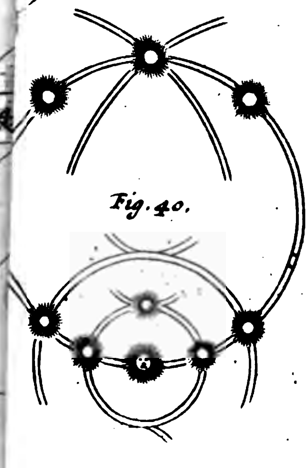


Fig. 40.

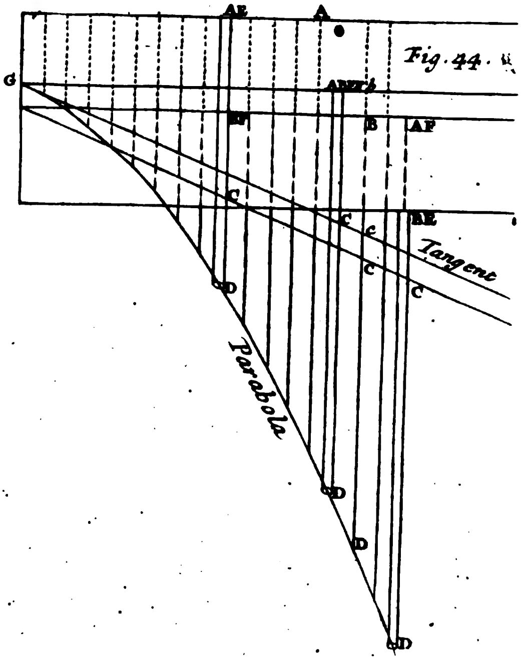


Fig. 44.

they would be at the *Top* of the *Water*, and remain there for divers Days, or perhaps Weeks; and ſometimes would fall to the Bottom, and after having continued there for ſome time (longer or ſhorter) they would again emerge. And though ſometimes (eſpecially if I removed the Veſſel that contained them to a Southern Window) they would riſe to the *Top*, or fall to the Bottom of the Water, according as the *Air* was *hot* or *cold*; yet 'twas not difficult to diſtinguiſh theſe Motions from thoſe produced by the *varying Gravity* of the *Atmoſphere*. For when the Beams of the Sun, or *Heat* of the ambient *Air*, by rarefying the *Air* included in the *Bubbles*, made that *Air* drive out ſome of the *Water*, and conſequently made the whole Bubble (conſiſting of *Glaſs*, *Air* and *Water*) ſomewhat lighter than a Bulk of Water equal to it, though the Bubble did neceſſarily ſwim as long as the included Air was thus *rarefied*, yet when the Abſence of the Sun, or any other Cauſe made the Air loſe its adventitious Warmth, there would enſue a *Condenſation* of the Air again; and thereupon an Intruſion of more Water (to ſucceed the Air) into the Glaſs, and conſequently a ſinking of the Bubble; and this would commonly happen at Night, if it did not happen ſooner. But when it was upon the Account of the varying Weight of the *Atmoſphere* that the Bubbles either roſe or fell, it appeared by the *Baroſcope*, that the *Atmoſphere* was ſo heavy or ſo light, that they ought to do ſo. Inſomuch that I divers times predicted, whether I ſhould find the *Mercury* in the *Baroſcope* high or low, by obſerving the Situation and Poſture of the Bubbles; and conſulting that Inſtrument, it verified my Conjectures. And though whilſt the *Atmoſphere* was not too conſiderably either light or heavy, the Changes of the Air as to Heat or Cold, would (as I was ſaying) place the Bubbles ſometimes at the Top, and ſometimes at the Bottom of the Water, within the Compaſs of a Day; yet if the *Atmoſphere* were either very heavy or very light, the Bubbles would continue at the Bottom or at the Top of the Water for many Days together, in Caſe the *Atmoſphere* did not in all that time change its *Gravity*. And I remember, that I did for Curioſity's ſake, when the Quick-ſilver was high in the *Baroſcope*, put the Glaſs two or three Days in a South-Window about Noon (and for a good while after) and that in ſun-ſhining Weather, and yet even then the Bubbles did not emerge, though it appeared by a good *ſeal'd Weather-Glaſs*, which I kept in the ſame Window, that the ambient Air was much warmer than at other times, when I had obſerved the Bubbles to keep at the Top of the Water.

N. B. 1. It being very difficult to *poiſe* ſeveral Bubbles preciſely, as well e as another, I thought it not ſtrange that all the three Bubbles did not nſtantly (though for the moſt part they did) riſe and fall together, but metimes two of them, and now and then (though ſeldom) one alone, ould ſink or emerge, when the Change of the Weight of the *Atmoſphere* was not conſiderably enough to operate ſenſibly upon the reſt. And therefore tis not amiſs to *poiſe* a great Number of Bubbles together, that after Trial made of all, the fitteſt may be choſen. For I have obſerved it ſometimes o happen that a Bubble that floated when 'twas firſt *poiſed*, would after a while ſubſide without any manifeſt Cauſe, or if it were made to ſink by ſuch a Cauſe, it would continue at the Bottom of the Water, though that Cauſe were removed; which difficult *Phænomenon* ſeeming to depend upon a kind of Imbibition made of certain Particles of an aereal Nature by the Water, the Conſideration of it belongs to another Place, not to this, where it may ſuffice, that the Experiment did ſometimes actually anſwer Expectation, as that above related did, wherein my main Drift was to ſhew, that ſince, as the *Atmoſphere* is heavier or lighter, 'tis capable to work upon Bodies under Water, ſo as to procure their ſinking, or their Emerſion; the Air (though a Fluid a thouſand times lighter) muſt lean or preſs upon the *Water* itſelf, by whoſe Intervention it produces theſe Effects, which confirms what I elſewhere teach, that the *Atmoſphere* is incumbent, as a heavy Body, upon the *terraqueous Globe*.

To take Exhauſted Receivers *away from the* Air Pump, *by* M. Papin, n. 120. p. 477.

LXXIV. I cauſed the Edges of my *Recipient* to be well ground, ſo as that being apply'd, it every where touched a Glaſs Plate, which had alſo been very ſmoothly ground to ſerve for a Cover to the ſame; and I ſpread a Piece of *Lamb-skin* wetted, over the ſaid Plate, and having thus applied it to the *Engine*, I put my *Recipient* over it: But in one Place there was a Hail-ſhot of Lead, which kept the *Receiver* from being exactly applied to its Cover, that ſo the Air might more freely get out. And having afterwards whelmed another great *Receiver* over all, I cauſed the *Pump* to be plyed. All being well *evacuated*, I ſhook the *Engine* ſo as that the little *Receiver* fell off from the Hail-ſhot, and ſtood every where cloſe to the Skin, expanded over the Cover of the Glaſs Plate. Then I had no more to do but to ſuffer the Air to re-enter into the great *Receiver*, and this Air preſſing upon the little one kept it ſo cloſely faſtened to its Cover, that it was impoſſible for me to ſever them. And I am aſſured, that the Air enters not into the ſmall *Receiver*, when 'tis thus applied upon the Skin; for I have often put *Gages* in them, which always kept at the ſame Height, altho' the Air was permitted to repaſs into the great *Receiver*. You might alſo let alone the putting under of the Hail-ſhot to keep up the little *Recipient*, becauſe the *Air* by its *Spring* would lift it up ſufficiently; but then the *Vacuum* would not be ſo perfectly made.

n. 121. p. 544.

When I firſt began to keep *Receivers* thus *void* of *Air*, I apply'd *Eels-Skins* to the Cover: But I found them not proper for Things that are intended to be conſerved a long Time, becauſe by drying they grow *ſpringy*, and this *Spring* is capable to raiſe the whole Pillar of *Air* that preſſes the *Receiver* againſt its Cover; and ſo the Air gets in between, and fills the place exhauſted.

Afterwards I employed *Mutton-Skins*; but that ſticks yet leſs cloſe than an *Eel-Skin*: For, as ſoon as the external Air comes to preſs upon it, it makes all the *Water*, which wetteth the Skin, that ſtands over without, enter into the emptied *Receiver*; and you may ſee little Drops of Water coming out of the Pores of the Skin that is under the *Receiver*; and after the Water is all entred, the Air quickly gets in the ſame Way.

At length I took a *Lamb-Skin*, and by means thereof I have kept *Receivers* empty 8 Days together, and never perceived it fail. Yet, for greater ſecurity, I do put *Turpentine* round about ſuch *Receivers* as I mean to keep ſtaunch a long Time. Mean while, this Difference betwixt the Skins of *Mutton* and *Lambs* is ſomewhat remarkable, and confirms what *Phyſicians* ſay of the different Conſtitution of Bodies in *Youth* and *Old Age*. I afterwards found that Paper wetted ſerves as well as a Lamb-Skin; but you muſt put *Turpentine* about it before it be dry.

Seeds *ſown in the* Exhauſted Receiver; *by* ---- n. 23. p. 425.

LXXV. Some *Lettice-Seed* being ſown upon ſome Earth in the open Air, and ſome of the ſame Seed at the ſame time upon other Earth in a Glaſs Receiver of the *Pneumatick Engine*, afterwards exhauſted of Air, the Seed expoſed to the Air was grown up an Inch and a half high, within 8 Days: But that in the exhauſted *Receiver*, not at all. And, Air being again admitted into the ſaid emptied *Receiver*, to ſee whether any of the Seed would then come up, it was found, that in the Space of one Week it was grown up to the height of two or three Inches.

Experiments concerning the Relation between Light *and* Air (*in* Shining Wood *and* Fiſh) *By Mr.* Rob. Boyl. n. 31. p. 581.

LXXVI. *Exp.* I. *Oct.* 29th, 1667. Having procured a Piece of *ſhining Wood*, about the bigneſs of a Groat or leſs, that gave a vivid Light (for *rotten Wood*) we put *it* into a middle-ſized *Receiver*, ſo as it was kept from touching the Cement; and the *Pump* being ſet a-work, we obſerved not, during the 5 or 6 firſt Exſuctions of the Air, that the Splendor of the included Wood was manifeſtly leſſened (though it was never at all increaſed;) but about the 7th Suck, it ſeem'd to grow a little more dim, and afterwards anſwered our Expectation, by loſing of its Light more and more, as the Air was ſtill farther pumped out; till at length about the 10th Exſuction, (though by the removal of the Candles out of the Room, and by black Cloaths and Hats we made the Place as dark as we could, yet) we could not perceive any Light at all to proceed from the *Wood*.

Exp. II. Wherefore we let in the outward Air by Degrees, and had the pleaſure to ſee the ſeemingly extinguiſh'd Light revive ſo faſt and perfectly, that it looked to us all almoſt like a little Flaſh of Lightning, and the Splendor of the Wood ſeemed rather greater than at all leſs, than before it was put into the Receiver.

But partly for greater certainty, and partly to enjoy ſo delightful a Spectacle, we repeated the Experiment with the like Succeſs as at firſt. Wherefore being deſirous to ſee how ſoon theſe Changes might be produced, we included the Wood into a very ſmall Receiver of clear Glaſs, and found, that in this the Light would begin to grow faint at the ſecond, or at leaſt at the third Exſuction of the Air, and at the 6th or 7th would quite diſappear. And we found by a Minute-Watch, that the ſending the Candles out of the Room, : pumping out the Air till the Wood would ſhine no more, the re-admitting the Air (upon which it would in a trice recover its Light) and the ſending n for the Candles to conſult the Watch, did in all take up but 6 Mi-nutes.

Exp. III. Having exhauſted this new Receiver till the Wood quite diſap-ared, we ſtaid ſomewhat above a quarter of an Hour in the Dark, without rceiving that the Wood had regained any thing of Light, tho' about the nd of this Time, we made the place about it as dark as we could; and then it being too late at Night to protract the Experiment, we let in the Air; upon whoſe Admiſſion the Wood preſently recovered Light enough to be conſpicuous at a Diſtance, though it ſeemed to be ſomewhat leſs vivid than before; which yet may be either a Weakneſs in my Sight, or an Effect of the Steams of the Cements, unfriendly perhaps to the Luminouſneſs of the Wood.

The Night following we put in a piece of Wood bigger than the former, this being above an Inch long, and that ſhone very vigorouſly; and having by a few Sucks quite deprived it of Light, we left it in the exhauſted Receiver for full half an Hour, and then coming into the dark Room again, we found all had not continued ſo ſtanch, but that ſome ſmall Portion of Air had inſinuated itſelf into the Receiver. This we concluded to be but a ſmall Portion of Air, becauſe the Wood was but viſible to an attentive Eye. And yet that it was really ſome Air which was got in, that cauſed the little glimmering Light which we perceived, may appear by this, that it did preſently (as we expected) vaniſh at the firſt or ſecond Suck; and then the Air being let into the dark Receiver, the included Wood preſently ſhone again as before; tho' I ſuſpected that I diſcerned ſome little Diminution of its Brightneſs; which yet till farther Trials of the like Kind, and for a longer Time, have been made, I dare not affirm.

Exp. IV. Having obſerved on another occaſion, That ſometimes the Operation, which the withdrawing the Air hath upon a Body included in the *Receiver*, proves more conſiderable ſome *Minutes* after we have ceaſed *Pumping*, than immediately after the Exerciſe is left off, I imagined, that even in ſuch Caſes, where the *Light* is not made wholly to diſappear (tho' it be made almoſt quite to do ſo) by the emptying of the *Pneumatical-Glaſs*, the ſuffering the Body to remain a while there, though without any *Pumping* (unleſs now and then a very little to remove the *Air*, that might have ſtolen in in the mean time) the remaining Light of the Body might probably be farther impaired, if not reduced quite to vaniſh. To examine this Conjecture, we put in a Body that was not *Wood*, which had ſome Parts much more *luminous* than the reſt; and having drawn out the Air, all the others diſappeared, and even the formerly brighter ones ſhone but faintly, when the *Pneumatical-Glaſs* ſeem'd to be exhauſted. But keeping the included Body a while in that unfriendly Place, we perceived the Parts that had retained Light, to grow more and more dim, ſome of them diſappearing; and that which was formerly the moſt conſpicuous, being now but juſt viſible to an attentive Eye, and that ſcarce without Diſpute; for if we had not known beforehand, that a ſhining Matter had been included in the *Receiver*, perhaps we ſhould not have found it out. (And he that had the youngeſt Eyes in the Company could not at all diſcern it;) but the Air being let in, the Body began to ſhine again.

Exp. V. The *Rarefaction* or *Expanſion* of the *Air*, having ſo notable an Operation upon our ſhining Wood, I thought it would not be amiſs to try what the *Compreſſion* of the *Air* would do to it: For which Purpoſe we included a Piece of it in ſuch a little Inſtrument to *compreſs* as hath been deviſed and propoſed by Mr. *Hook*. But tho' we impelled the Air forcibly enough into the Glaſs, yet by reaſon of the Thickneſs requiſite in ſuch Glaſſes, and the Opacity thence ariſing, we were not able then to determine, whether or no any Change was made in the *Luminouſneſs* of the *Wood*. Which I thought the leſs ſtrange, becauſe by ſome *Experiments* purpoſely deviſed, I had long ſince obſerved, That even a great Preſſure from a fluid Body, which preſſeth more uniformly againſt all the Parts it toucheth of the conſiſtent Body, does work a far leſs manifeſt Change even on ſoft or tender Subſtances, than one would expect from the Force wherewith it compreſſeth.

Exp. VI. Thinking fit to try whether a ſmall Quantity of Air, without being ventilated or renewed, might not ſuffice to maintain this cold Fire, tho' it will not that of a live Coal, or a Piece of Match, we cauſed a Piece of ſhining Wood to be hermetically ſealed up in a Pipe of clear and thin Glaſs; but tho' carrying it into the Dark, we found it had quite loſt its Light, yet imagining that that might proceed from its having been over-heated (being ſealed up in a Pipe not long enough to afford it a due Diſtance from the Flame of the Lamp we employed to ſeal it) we cauſed 2 or 3 Pieces of freſh *Wood*, amounting all of them to the Length of about two Inches, to be ſeal'd up in a ſlender Pipe between 4 or 5 Inches in Length; which being warily done, the Wood retained its Light very well, when the Operation was over, and afterwards laying it by my Bed-ſide, when the Candles were carried away out of the Room, I conſidered it a while before I went to ſleep, and found it to ſhine vividly.

The next Morning when I awaked, tho' the Sun was riſen, yet forbearing to draw open the Curtains of my Bed 'till I had looked upon the ſeal'd Glaſs, *which* I had fenced with a Piece of Cloth held between it and the Window, my Eyes having not yet been expoſed to the Day-light, ſince the Darkneſs they had been accuſtomed to during the Night, made me think the *Wood* ſhined brighter than ever. And at Night, after 10 of the Clock, looking on it in a dark Place, it appeared luminous all its length, though not ſo much as in the Morning.

The Morning after, and the Night after that, the ſame Wood did likewiſe manifeſtly, though not vigorouſly, ſhine; eſpecially one Piece, whoſe Light was much more vivid than the reſt: And, for ought I know, I might have obſerved them to ſhine longer, if one of the ſealed Ends of the Glaſs had not been accidentally broken.

Exp. VII. I cauſed a Piece of Iron to be forged, whoſe Top was of the Bigneſs of a Nutmeg; the reſt being a Stem of an Inch, or an Inch and a half long, for which we provided a little Candleſtick of Tobacco-Pipe Clay, which would yield any Smoak to fill and darken the Receiver. Then having heated the n red-hot, and placed it in this Clay, ſo that the round Part was clearly otuberant, we conveyed it into a *Receiver* of white Glaſs, which was ſo ced, as to keep the Sides at as great a Diſtance as we could from the Iron, the exceſſive Heat ſhould (as we much feared it would) break the Glaſs. en ſending away the Candles, and making the Room dark, we haſtily nped out the Air, but could not perceive the withdrawing of it had any ration on the glowing Iron. And though it continued ſhining long enough to give us an Opportunity to pump out and let in the Air three ſeveral Times, yet we could not obſerve, that the Air had any manifeſt Operation one Way or other. For though upon the withdrawing of the Air the Iron grew dimmer and dimmer, yet that I attributed to the cooling of it; and the rather, becauſe having (to examine the Conjecture) let in two or three times the Air, when the *Receiver* had been exhauſted, there appeared no manifeſt Increaſe of Light upon the ſudden Admiſſion of it.

Exp. VIII. Some curious Perſons would perhaps, if they had been preſent, have deſired to ſee a Trial made, whether or no a ſmall Piece of *ſhining Wood*, being ſo included in the *Receiver*, as that the pumping out of the *Air* ſhould have no injurious Operation upon the Body of it, its Light would, upon the withdrawing of the *Air*, be manifeſtly diminiſhed: This Way I was the leſs backward to try, becauſe it did not readily occur to my Memory, that by any manifeſt Experiment it appeared, that a Body, more thin than *Air*, will, or can, tranſmit Light, as well as other Diaphanous Mediums. Wherefore having *hermetically ſealed* up a Piece of ſhining Wood in a ſlender Pipe, and placed it in a ſmall *Receiver* that was likewiſe made of clear Glaſs, we exhauſted it of *Air*, and afterwards let in again that which we had excluded. But by neither of the Operations could we perceive any ſenſible Decrement or Increaſe of the Light of the Wood; though by that very Obſervation it appeared, that the Glaſs had been well ſealed, ſince otherwiſe the included *Air* would have got out of the Pipe into the *Receiver*, and have left the Wood without Light.

Exp. IX. I took an old, but thin Glaſs, ſealed at one End, whoſe Shape was pretty cylindrical, and whoſe Bore was about the Bigneſs of a Man's little Finger, and whoſe Length was about a Foot or more. Into this Pipe, near the ſealed End, we put a Piece of *ſhining Wood*, wedged in with a Piece of Cork to keep it from falling; and having inverted the Noſe of it into another ſlender Glaſs, but not cylindrical, wherein was pretty Store of Quickſilver, we put them both into a long *Receiver*, ſhaped almoſt like a Glaſs Churn; and having pumped a while, that the *Air* included in the Pipe expanding itſelf, might depreſs the Quickſilver, and ſo make Eſcapes into the *Receiver* as long as we thought fit; we then let in the outward Air, that the *ſtagnant* Quickſilver might be impelled into the Cavity of the Pipe now freed from much of the Air, to the Height requiſite for our Purpoſe.

This done, we plied the Pump again, and obſerved, that as the Air in the Pipe did by its own Spring expand itſelf more and more, and grow thinner and thinner, the *ſhining Wood* grew dimmer and dimmer, till at length it ceaſed to ſhine, the internal Air being then got a good way lower than the Surface of the external Quickſilver; whereupon opening the Commerce between the Cavity of the *Receiver*, and the *Atmoſphere*, the Quickſilver was driven up again, and conſequently the Air above it was reſtored to its former Denſity; upon which the rotten Wood alſo recovered its Light. What the greateſt Expanſion of this Air was, we could not certainly determine, becauſe the Expanſion raiſed the external Quickſilver ſo high, as to hinder us to ſee and meaſure it: But we gueſſed, that the Air reached to about a Foot a Foot or more from the Top of the Pipe to the Surface of the Quickſilver near the Bottom of it. But when that rarified Air was impelled into its former Dimenſions, we meaſured it, and found, that the upper Part of the Tube, unpoſſeſt by the Quickſilver, was about 3 Inches; and the Wood being about an Inch long, there remained two Inches or ſomewhat better for the Air. But this Experiment ought to be repeated, when exacter Inſtruments can be procured.

Exp. X. Thinking it fit to try, as well, whether ſtinking Fiſh that ſhines, be of the ſame Nature, as to *Luminouſneſs*, with rotten Wood that ſhines too; as, whether the withdrawing of the Air will extinguiſh or eclipſe the Light of a conſiderable Bulk of *luminous Matter*, as in the Experiments hitherto made, we found it would do to a ſmall one; we took a Fiſh that we had kept, and cauſed to be watched till it was almoſt all over *luminous*, though much more in the Belly, and ſome Parts of the Head, than elſewhere: And having ſuſpended him in a conveniently ſhaped *Receiver*, we found him to give ſo great a Light, that we ſuſpected beforehand that the withdrawing of the Air would hardly have its full Operation upon a Body, whoſe Bulk was conſiderable as well as its Light very vivid, and which had many *luminous* Parts retired to a pretty Diſtance from the Air. Accordingly having exhauſted the *Receiver* as much as we were wont, it appeared indeed, eſpecially towards the latter End of the Operation, that the Abſence of the Air did conſiderably leſſen, and in ſome Places eclipſe the Light of thoſe Parts that ſhone leſs ſtrongly: But the Belly appeared not much leſs *luminous* than before. Wherefore ſuppoſing, that upon the turning of the *Stopcock*, the Air coming in much more haſtily than it could be drawn out, we ſhould have the beſt Advantage to diſcern, what Intereſt it had in the *Luminouſneſs* of the Fiſh, we re-admitted it: And upon its ruſhing in, perceived the Light to be, as it were, revived and encreaſed; thoſe Parts of the Fiſh that were ſcarce viſible before, or ſhone but dimly, receiving preſently their former Splendor.

And not to leave unproſecuted the remaining Part of the Experiment, which was to try, whether it was the Kind of the *luminous Body*, or only the Greatneſs of the *Bulk*, and the *Vividneſs* of *Light*, and, if I may ſo ſpeak, the Tenacity of the Subſtance it reſided in, that made the Difference between the *Fiſh* and *Wood*; we put Part of a Fiſh of another Kind, that ſhone much more faintly than that hitherto ſpoken of, and but in ſome Places; and by the withdrawing the Air, we made ſome of the luminous Parts diſappear, and the others ſo dim, as ſcarce to be diſcerned; and yet both the one and the other ined their former Light upon the Return of the Air.

nd to purſue the Experiment a little farther, we put in ſuch a Piece of firſt Fiſh, as though it were bright, was yet but thin, and not conſidera- great; and upon pumping out the Air, we found it, according to our pectation, quite eclipſed, though it recovered its Light upon the Air's entry.

Tis probable that ſome will make uſe of this Diſcourſe to countenance ir Opinion, That notwithſtanding the Coldneſs (at leaſt as to Senſe) of

Fiſhes and other Animals, there may be in the Heart and Blood a vital Kind of Fire which needs Air, as well as thoſe Fires which are ſenſibly hot: Which may leſſen the Wonder, that Animals ſhould not be able to live when robb'd of Air.

Exp. XI. To examine the Conjecture mentioned in the laſt Experiment, That the Durableneſs of the Light in the ſhining Fiſh, in ſpight of the withdrawing the Air, might proceed in great Part from the *Vividneſs* of it, and the Beauty of the Matter it reſided in, rather than from the Extent of the luminous Body, in Compariſon of the ſmall Pieces of ſhining Wood, I hitherto had made my Trials with; in *Dec.* 1667. I got a large Piece of Wood, whoſe luminous Superficies might be perhaps 10 or 12 times as great as that which the Eye ſaw at once of the Surface of ſuch Fragments of ſhining Wood as I was wont to employ: And though ſome Parts of this large Superficies ſhined vividly enough (for rotten Wood, for the Light was uſually inferior to that of our Fiſh) yet this great Piece being put into a convenient Receiver, was, upon the withdrawing of the Air, deprived of Light, as the ſmaller ones had been formerly; the returning Air reſtoring its Light to the one, as it had done to the other.

Exp. XII. I took ſome ſmall Pieces of rotten Fiſh, that ſhone, ſome of them more faintly, and ſome of them more vividly, in reference to one another, but none as ſtrongly as ſome that I could have employed; and having in a very ſmall and clean Receiver ſo far drawn off the Air, as to make the included Body diſappear, we ſo ordered the Matter, that we kept out the Air for about 24 Hours; and then allowing the Air to re-enter in a dark Place, and late at Night, upon its firſt Admittance the Fiſh regained its Light.

Exp. XIII. This compared with ſome of my former Obſervations about Putrefaction, put me upon a Trial, which, tho' it miſcarried, I ſhall here make mention of, that in caſe you, who are better furniſhed with Glaſſes, think it worth while, you may get reiterated by the Society's Operator; conſidering how great an Intereſt *Putrefaction* hath in the *ſhining* of *Fiſhes*, and *Air* in the *Phænomena* of *Putrefaction*. I thought it might be ſomewhat to the Purpoſe, to take a *Fiſh*, that was, according to the common Courſe I had obſerved in Animals, not far from the State, at which it would begin to *ſhine*; and having cut out a Piece of it, I cauſed the reſt to be hung up again in a Cellar, and the exſected Piece to be put into a ſmall and tranſparent Receiver, that we might obſerve, if a Day or two, or more, after the Fiſh in the Cellar ſhould begin to ſhine, that in the exhauſted Receiver would either alſo ſhine, or (becauſe that ſeemed not likely) would, notwithſtanding the Check which the Abſence of the Air might be preſumed to give the *Putrefaction*, be found to ſhine too, either immediately upon the Admiſſion of the Air or not long after it.

not

But this *Experiment* was only deſigned and attempted, not compleated; the *Receiver* being ſo thin, that upon the *Exhauſtion* of the internal Air, the Weight of the external broke it, and we could ſpare another of that Kind from Trials, we were more concerned to make: Notwithſtanding which we made one Trial more, which ſucceeded no better than the former, but miſcarried

carried upon a quite different Account, *viz.* Becauſe neither the included Piece of Fiſh, nor the remaining, tho' it were of the ſame Sort with the Fiſhes I uſually employed, would ſhine at all, tho' kept a pretty while beyond the uſual Time, at which ſuch Fiſhes were wont to grow luminous. But that this Paragraph may not be uſeleſs to you, I'll take this Occaſion to give you a couple of Advertiſements, that may relate not only to this Experiment, but alſo more generally to thoſe whether precedent or ſubſequent, where *ſhining Fiſh* are employ'd.

Advertiſement I. In the firſt place then, I will not undertake, that all the Experiments you ſhall make with rotten Fiſh, ſhall have juſt the ſame Succeſs with theſe I have related. For, as I elſewhere obſerved, that the Event of divers other Experiments is not always certain, ſo I have had Occaſion to obſerve the like about *ſhining* of *Fiſhes*. And I remember, that having once deſigned to make Obſervations about the Light of rotten Fiſhes, and having, in order thereunto, cauſed a competent Number of them to be bought, not one of them all would ſhine; tho' they were bought by the ſame Perſon I was wont to employ, and hung up in the ſame Place where I uſe to have them put, and kept not only till they began to putrify, but beyond the Time that others uſed to continue to ſhine: Altho' a Parcel of the ſame Kind of Fiſhes, bought the Week before, and another of the ſame Kind, bought not many Days after, *ſhined* according to Expectation. What the Reaſon of this Diſappointment was, I could not determine; only I remember, that at the Time it happened, the Weather was variable, and not without ſome Days of Froſt and Snow.

Adver. II. Notice muſt alſo be taken in making Experiments with *ſhining Fiſh*, that their *Luminouſneſs* is not wont to continue very many Days: Which Advertiſement may be therefore uſeful, becauſe, without it we may be apt ſometimes to make Trials, that cannot be ſoon enough brought to an Iſſue, and ſo we may miſtake the Loſs of Light in the Fiſh to be a Deprivation of it, cauſed by the *Experiment*, which indeed is but a Ceſſation according to the uſual Courſe of Nature.

Exp. XIV. We put a Piece of *ſhining Fiſh* into a wide-mouth'd Glaſs, about half fill'd with fair Water, and having plac'd this Glaſs in a *Receiver*, we exhauſted the Air for a good while, to obſerve, whether when the *Preſſure* of the Air was removed, and yet (by Reaſon of the Water that did before keep the Air from immediately touching the Fiſh) the Exhauſtion of the Receiver did not deprive the Fiſh of that Contact of Air, which it had loſt before; whether, I ſay, in this Caſe the Abſence of the Air would have the ſame Influence on the ſhining Body, as in the former Experiments.

And here, as far as the numerous Bubbles excited in the Water would give us leave to diſcern it, we could not perceive, that either the Abſence or Return of the Air had any great Operation upon the Light of the immerſed Body.

I ſhall here inform you, that tho' when I formerly put together ſome Notes about luminous Bodies, I confined not my Obſervations to one or two Sorts of Fiſhes; yet theſe Experiments were all of them (except a collateral one or two) made with *Whitings*, which, among the Fiſhes I have had Occaſion to take Notice of, is (except one ſort that I cannot procure) the fitteſt for ſuch Trials.

Exp. XV. To proſecute the I. and IX. Experiments in one Trial, we took ſomewhat late at Night a Piece of rotten Fiſh, which we judged to ſhine too ſtrongly to be quickly deprived of all its Light; and having put it into a ſmall and clear *Receiver*, we found, as we had foreſeen, that the *Light* was much impaired, but nothing near ſuppreſſed by the withdrawing of the Air. Wherefore having removed the *Receiver* into a convenient Place, I cauſed it to be brought to me about Midnight, and having made the Place pretty dark, I perceived the included Body to continue to ſhine more vividly than one would have expected (and, if I miſtake not, I ſaw it ſhining in the Morning whilſt it was dark;) but the Night after, coming to look upon it again, its *Light* appeared no more: Notwithſtanding which, I made a Shift to keep out the Air about 24 Hours longer, and ſo after 48 Hours in all, we opened the *Receiver* in a dark Place, and preſently upon the *Ingreſs* of the Air, were pleaſingly ſaluted with ſo vivid an Apparition of Light, that the included Body continued to ſhine, when carried into a Room, where there was both Fire and Candle, if it were but by a *Hat* skreen'd from the Beams.

Being encouraged, as well as pleaſed with this Succeſs, we forthwith exhauſted the Air once more out of the ſame Receiver, and having kept it about 4 Hours longer, we look'd upon it again in a dark Place, and finding no Appearance of Light, let the Air in upon it, whereby it was made to ſhine again, and that vigorouſly enough.

The Suddenneſs, with which the included Body appeared to be, as 'twere, *rekindled* upon the firſt Contact of the *Air*, revived in me ſome Suſpicions, I have had, about the poſſible Cauſes of theſe *ſhort-liv'd Apparitions of Light* (for I ſpeak not now of real Lamps found in Tombs, for a Reaſon to be told you another Time) which diſcloſing themſelves upon Mens coming in, and conſequently letting in freſh Air into Vaults, that had been very long cloſe, did ſoon after vaniſh.

Theſe Thoughts, as I was ſaying, occurred to me upon what I had been relating, by Reaſon of the *ſudden Operation* of the freſh Air upon a Body, that but a Minute before diſcloſed no *Light*. For though the *Lights* reported to have been ſeen in Caves, quickly diſappeared, which that of our Fiſh did not; yet that Difference might poſſibly proceed from the Tenacity, or ſome other Diſpoſition of the Matter, wherein the *Luminouſneſs* of the Fiſh reſides: For I remembred that I had more than once obſerved a certain glimmering and ſmall *Light* to be produced in a Sort of Bodies, upon putting them out of their former Reſt, and taking them into the Air; which Sparks would vaniſh themſelves, ſometimes within one Minute, ſometimes within a few Minutes. But as theſe Thoughts were but tranſient Conjectures; ſo I ſhall not entertain you any longer about them, but rather contenting myſelf with the Hint already given, take Notice of what may be more certainly deduced from our Experiment, which is, that the Air may have a much greater Intereſt in divers odd *Phænomena* of Nature, than we are hitherto aware of.

And for Confirmation of our Experiment, I ſhall add, that having in another *Receiver* eclipſed a Piece of Fiſh that ſhone when 'twas put in more *languidly* than divers others we had tried, I kept it about 3 Days and 3 Nights in a *Receiver*; after which I opened it in the Dark, and upon letting in the Air upon this Body, that ſhined but faintly at firſt, it immediately recovered its ſo long ſuppreſſed Light. And having included another Piece that was yet more faint than this, when it was put into the *Receiver*, and having kept this Piece alſo 3 Days and 3 Nights in the exhauſted Glaſs, I let in the Air upon it; and notwithſtanding the Darkneſs of the Place, nothing of Light was thereupon revived. But this being little other than I expected from a Body that ſhined ſo faintly, when 'twas put into the *Receiver*, and had been kept there ſo long, I reſolved to try whether the Appulſe and Contact of the Air would have that Operation after ſome Time that it had not at firſt; and accordingly, after having waited a while, I obſerved the Fiſh to diſcloſe a Light, which tho' but dim, was yet manifeſt enough.

I ſhall only add, That having included in ſmall *Receivers* 2 Pieces of rotten *Whitings*, whereof the one, before it was put in, ſcarce ſhone ſo vividly as did the other after the *Receiver* was exhauſted; and having ordered the Matter ſo, that we were able to keep out the Air for ſome Days, at the End of about 48 Hours, we found, that the more ſtrongly ſhining Body retained yet a deal of Light; but afterwards looking upon them both in a dark Place, we could not perceive in either any Shew of Light. Wherefore having let in the Air into that *Receiver*, whereinto the Body that at firſt ſhined the faintſier had been put, there did not enſue any glimmering of Light for a pretty while; nay, upon the ruſhing in of the Air into the other Glaſs, the Body that at firſt ſhone ſo ſtrongly, and that continued to ſhine ſo long, ſhewed no glimmering of Light. But within leſs than a Quarter of an Hour we ſaw a manifeſt Light in the Body laſt named, and a while after the other alſo became viſible, but by a Light very dim. The more luminous of theſe Bodies I obſerved to retain ſome Light 24 Hours after; and the hitherto recited Experiment had this peculiar Inſtance in it, that the 2 *Receivers* were uninterruptedly kept exhauſted no leſs than 4 Days, and as many Nights.

Pneumatical *Experiments*; *By Mr.* Boyle, n. 62. p. 2011. *Upon Ducks.*

LXXVII. I. 1. We put a full grown Duck into a *Receiver*, whereof ſhe filled, by our Gueſs, a third Part, or ſomewhat more, but was not able to ſtand in any eaſy Poſture in it; then pumping out the Air, within the ſhort Space of one Minute, ſhe appeared much diſcompoſed, and between that and the ſecond Minute, her ſtruggling and convulſive Motions increaſed ſo much, that her Head alſo hanging careleſly down, ſhe ſeemed to be juſt at the Point of Death: So that it did not appear, that, notwithſtanding the peculiar Structure of ſome Veſſels about the Heart, which enable theſe and other Water-Birds to continue without Reſpiration for ſome Time under the Water, this Duck was able to hold out conſiderably longer than a Hen, or other Bird not aquatick might have done.

This Duck, being revived upon the Admiſſion of freſh Air, and again ſhut up in the ſame *Receiver* with the Air in it, continued five Times as long as before without appearing any ways diſcompoſed.

2. We conveyed a Duckling, that was not yet callow, into the ſame *Receiver*, and obſerved, that before the firſt Minute was quite ended, ſhe gave manifeſt Tokens of being much diſordered, and before a ſecond Minute was expir'd, ſeveral convulſive Motions obliged us to let the Air in upon her, whereby ſhe quickly recovered.

N. B. When the *Receiver* was pretty well exhauſted, ſhe appear'd manifeſtly bigger than before the Air was withdrawn, eſpecially about the Crop, tho' that was very turgid before. We kept the ſame Duckling in the ſame *Receiver* very cloſe, to keep out all external Air, and to keep in the *excrementitious* Steams of her Body for above 6 Minutes, without perceiving her to grow ſick upon her Impriſonment.

Vipers. II. 1. *Jan.* $166\frac{2}{3}$. We included a Viper in a ſmall *Receiver*, and as we drew out the Air, ſhe began to ſwell, and afforded us theſe *Phænomena*.

1. It was a good while after we had left pumping, e'er the Viper began to ſwell ſo much as to be forced to gape; which afterwards ſhe did.

2. That ſhe continued, by our Eſtimate, above $2\frac{1}{2}$ Hours in the exhauſted *Receiver*, without giving clear Proof of her being killed.

3. That after ſhe was once ſo ſwell'd, as to be compelled to open her Jaws, ſhe appear'd ſlender and lank again, and yet very ſoon after appear'd ſwell'd again, and had her Jaws disjoined as before.

2. We took a Viper, and including her in the greateſt Sort of ſmall *Receivers*, we emptied the Glaſs very carefully, and the Viper moved up and down within, as it were to ſeek for Air, and after a while foamed a little at the Mouth, and left of that Foam ſticking to the inſide of the Glaſs. Her Body ſwelled not conſiderably, and her Neck leſs, till a pretty while after we had left pumping; but afterwards the Body and Neck grew prodigiouſly tumid, and a Bliſter appeared upon the Back. An Hour and an Half after the Exhauſtion of the *Receiver* (which we then, by Trial, found to be pretty ſtanch) the diſtended Viper did give by Motion, manifeſt Signs of Life; but we obſerved none afterwards. The Tumour reached to the Neck, but did not ſeem much to ſwell the under Chap. Both the Neck and a great Part of the Throat being held betwixt the Eye and the Candle, were tranſparent enough, where the Scales did not darken them. The Jaws remained mightily opened, and ſomewhat diſtorted; the *Epiglottis* with the *Rimula Laryngis* (which remained gaping) was protruded almoſt to the farther End of the nether Chap. As it were, from beneath this *Epiglottis* came the black Tongue, and reached beyond it, but ſeemed by its Poſture not to have any Life, and the Mouth alſo was grown blackiſh within: But the Air being re-admitted after 23 Hours in all, the Viper's Mouth was preſently cloſed, though ſoon after it was opened again, and continued long ſo; and ſcorching or pinching the Tail made a Motion in the whole Body, that argued ſome Life.

3. *April* 25. We included an ordinary harmleſs Snake, together with a Gage, in a pretty portable *Receiver*, which, being exhauſted and well ſecured againſt the *Ingreſs* of the *Air*, was laid aſide in a quiet Place, where it continued from 10 or 11 a-Clock in the Forenoon, till about 9 the next Morning;

and then, though he ſeemed to be dead, and gave no Signs of Life upon the ſhaking of the *Receiver*; yet upon holding the Glaſs at a convenient Diſtance from a moderate Fire, he did in a ſhort Time manifeſt himſelf to be alive by ſeveral Tokens, and even by putting forth his forked Tongue. In that Condition I left him, till the next Day, early in the Afternoon; at which Time he was grown paſt Recovery, and his Jaws, which were formerly ſhut, gaped exceeding wide, as if they had been ſtretched open by ſome external Force.

Frogs.

III. 1. *Sept.* 9, 1662. We took a large luſty Frog, and having included her in a ſmall *Receiver*, we drew out the Air, and left her not very much ſwell'd, and able to move her Throat from Time to Time, though not ſo faſt as when ſhe freely breathed before the Exſuction of the Air. She continued alive about 2 Hours that we took Notice of, ſometimes removing from the one Side of the *Receiver* to the other; but ſhe ſwelled more than before, and did not appear by any Motion of her Throat or Thorax to exerciſe Reſpiration; but her Head was not very much ſwell'd, not her Mouth forced open. After ſhe had remained there ſomewhat above 3 Hours (for it was not 3½ Hours) perceiving no Sign of Life in her, we let in the *Air* upon her, with which the formerly tumid Body ſhrunk very much, but ſeemed not to have any other Change wrought in it; and though we took her out of the *Receiver*, yet in the *free Air* itſelf, ſhe continued to appear ſtark dead. Neverthleſs to ſee the utmoſt of the Experiment, having cauſed her to be laid upon the Graſs in a Garden all Night, the next Morning we found her perfectly alive again.

2. *Jan.* 29, 1660. About 11 of the Clock in the Forenoon, we put a *Frog* into a ſmall *Receiver*, containing about 15¼ *Ounces Troy* Weight of *Water*, out of which we had tolerably well drawn the *Air* (ſo that when we turned the Cock under *Water*, it ſucked in about 13¼ *Ounces* of *Water* :) The *Frog* continued in it (the *Receiver* all the while under *Water*) *lively* enough till about 5 of the Clock in the Afternoon, when it expired. The *Frog* at the firſt ſeemed not to be much altered by the *Exſuction* of the *Air*, but continued *breathing* both with her Throat and Lungs.

3. *Sept.* 6th, 1662. We included into a large *Receiver* a couple of *Frogs* newly taken, the one not above an Inch long, and proportionally ſlender; the other very large and luſty. Whilſt the *Air* was drawing out, the leſſer *Frog* ſkipped up and down very lively, and ſomewhat to our Wonder, clambered up ſeveral Times to the Sides of the *Receiver*, inſomuch that he ſometimes reſted himſelf againſt the Sides of the Glaſs, when his Body ſeemed to be perpendicular to the *Horizon*, if not in a *reclining Poſture*. He continued to ſkip up and down a while after the *Exſuction* of the *Air*, but within a quarter of an Hour (meaſured by a *Minute-Watch*) we perceived him to lie ſtark dead, with his Belly upwards. The other *Frog* that was very large and ſtrong, tho' he began to ſwell much upon the withdrawing of the *Air*, and ſeemed to be diſtreſſed, by his frequently leaping up, after the *Air* was drawn out, which he did not before, yet being as we ſaid very luſty, he held out half an Hour; at which Time the Weight of the outward *Air* broke the *Receiver*, and thereby brought him a Reprieve.

4. *Sept.* 11. We took a ſmall *Frog*, and having conveyed her into a very ſmall portable *Receiver*, we began to pump out the Air. At firſt ſhe was lively enough, but when the Air began to be conſiderably withdrawn, ſhe appeared to be very much diſquieted (leaping ſometimes after an odd Manner, as it were to get out of the uneaſy Priſon) but yet not ſo, but that after the Operation was ended, and the *Receiver* taken off, the *Frog* was perfectly alive, and continued to appear ſo (if I am not miſtaken) near an Hour, tho' the *Abdomen* was very much, and the *Throat* ſomewhat extended; this latter Part having alſo left that wonted panting Motion that is ſuppoſed to argue and accompany the *Reſpiration* of *Frogs*. At the end of about 3¼th Hours, after the Removal of the *Receiver* from the *Pump*, the Air was let in; whereupon the *Abdomen*, which by that Time was ſtrangely ſwelled, did not only ſubſide, but ſeemed to have a great Cavity in it, as the Throat alſo proportionally had; which Cavities continued, the *Frog* being gone paſt all Recovery.

5. *Apr.* 14. A large *Frog* was conveyed into a plated *Receiver*, and the *Air* being withdrawn, her Body by Degrees was diſtended. The *Receiver* with the *Gage* were kept under Water near 7 Hours; at the End of which I found the *Receiver* ſtaunch, but the *Frog* dead and exceedingly ſwelled; upon the letting in of the *Air*, ſhe became more hollow and lank than ever.

Kitlings. IV. Being deſirous to try whether *Animals* that had lately been accuſtomed to live either without any, or without a full *Reſpiration*, would not be more difficultly or ſlowly killed by the want of the *Air*, than others, which had been longer uſed to a free *Reſpiration*; we took a *Kitling* that had been kitten'd the Day before, and put it into a very ſmall Receiver that we gueſſed to hold about a Pint or leſs, that it might be the ſooner exhauſted. Within one *Minute*, or a little more, after the *Air* firſt began to be withdrawn, the little Animal, who in the mean Time had gaſped for Life, and had ſome violent *Convulſions*, lay as dead, with its Head downwards, and its Tongue out; but upon letting in of the Air, it did in a Trice ſhew Signs of Life, and being taken out of the *Receiver*, quickly recovered.

Another of the ſame Litter being put into the ſame *Receiver*, quickly began, like the other, to have *Convulſions*, after which it lay as dead. But tho' we continued pumping, and could not perceive that the *Engine* leaked more than in the former Experiments; the *Kitling* began to ſtir again, and after a while had ſtronger and more general *Convulſions* than before, till at the End of full 6 *Minutes* after the *Exſuction* of the *Air* was begun, the *Animal* ſeeming quite dead, was taken out of the Veſſel, and lay with its Mouth open, and its Tongue lolling out, without any ſenſible Breathing and Pulſation; till having ordered it to be pinched, the Pain, or ſome internal Motion, produced by the external Violence done to it, made it immediately give manifeſt Signs of Life; tho' there was yet no ſenſible Motion of the *Heart* or the *Lungs*; but afterwards gaping and fetching its *Breath* in an odd Manner, and with much ſtraining, as I have ſeen ſome *Fœtus*'s do when cut out of the *Womb*, it by little and little, within about a quarter of an Hour, recovered.

Incloſing another *Kitling* kitten'd at the ſame Time, in the ſame *Receiver*, we obſerved, that divers violent *Convulſions*, as it were gaſping for Breath, into which it began to fall at the ſecond or third Suck' ended in a ſeeming Death, within about a Minute and a half. A while after, notwithſtanding our continuing to pump, the *Kitling* gave manifeſt Signs of Life, which was not till it had endured divers Convulſions, as great as thoſe of the firſt Fit, if not greater. When 7 *Minutes* from the Beginning of the Exhauſtion were completed, we let in the *Air*, upon which, the little Creature that ſeem'd ſtark dead before, made us expect that it might recover; but tho' we took it out of the *Receiver*, and put *Aqua-vitæ* into its Mouth, yet it irrecoverably died in our Hands.

By what has been related, it appears, that thoſe Animals continued 3 Times longer in the exhauſted Receiver, than other Animals of that Bigneſs would probably have done.

The Air concealed in the Pores of Liquors.

V. 1. We put ſome Water in an open *Tube*, and ſuffered the *Air latitant* in it to eſcape in an *exhauſted Receiver*, without any Artifice to catch it; by which Trial, the Water did not part with any thing of its Bulk, that made a Diminution ſenſible to the Eye.

2. A chymical Pipe, ſealed at one End, and 36 *Inches* (or ſomewhat leſs) in Length, was filled with Water, and inverted into a Glaſs Veſſel, not two *Inches* in Diameter, and but $\frac{1}{4}$th of an *Inch* or little more in Depth. Theſe Glaſſes being conveyed into a fit Receiver, and the *Air* being leiſurely pump'd out, and ſomewhat ſlowly re-admitted, the numerous Bubbles that had aſcended during the Operation, conſtituted at the Top an *Aereal Aggregate*, amounting to $\frac{4}{10}$ wanting about an 100 Part of an *Inch*.

3. Preſently after, another Tube was filled again with the ſame Water, and inverted, and the Water being drawn down to the Surface of the veſſelled Water, and the Air let in again, the Water was impelled up to the very Top, within a 10th and half a Tenth of an *Inch*.

4. The *Tube* for meaſuring the *Air* latitant in the Water, was 43 $\frac{1}{2}$ *Inches* above the Surface of the ſtagnant Water: The *Air* collected out of the Bubbles at the Top of the Water, was the firſt Time $\frac{1}{4}$ of an *Inch*, and ſomewhat better; the ſecond Time we eſtimated it but $\frac{1}{8}$ and $\frac{1}{16}$. The firſt Time the Water in the *Pipe* was made to ſubſide full as low as the Surface of the reſtagnant Water: The ſecond Time, the loweſt we made it ſubſide ſeem'd to be 4 or 5 *Inches* above the Surface of the Water in the open Veſſel.

I muſt here advertiſe, that the *Air* at the Top of the *Tube* did poſſeſs more Room than its Bulk did abſolutely require, becauſe it was ſomewhat defended from the Preſſure of the *Atmoſphere* by the Weight of the ſubjacent *Cylinder* of *Water*, which might be about 3 or 4 Foot long.

5. We provided a clear round *Glaſs*, furniſhed with a *Pipe* or *Stem* of about 9 *Inches* in Length, the *globulous Part* of the Glaſs being on the outſide about 3$\frac{1}{2}$ *Inches* in Diameter; the *Pipe* of this Glaſs was within an *Inch* of the Top melted at the Flame of a Lamp, and drawn out for two or three Inches as ſlender as a *Crow*'s Quill, that the Decrement of the *Water* upon the Receſs of the *Air* harboured in its *Pores*, might, if any ſhould happen, be the more

eaſily obſerved and eſtimated. Above this ſlender Part of the *Pipe*, the *Glaſs* was of the ſame Largeneſs (or near it) with the reſt of the *Pipe*, that the *Aerial Bubbles*, aſcending thro' the ſlender Part, might there find Room to break, and ſo prevent the overflowing, or Loſs of any Part of the *Water*.

This Veſſel being, not without Difficulty and ſome Induſtry, filled, till the *Liquor* reached to the Top of the ſlender Part, where not being uniformly enough drawn out, it was ſomewhat broader than elſewhere, we conveyed the Glaſs, together with a Pedeſtal for it to reſt upon, into a tall *Receiver*, and pumping out the Air, there diſcloſed themſelves numerous *Bubbles* aſcending nimbly to the upper Part of the *Glaſs*, where they made a kind of Froth or Foam; but by Reaſon of the above-mentioned Figuration of the Veſſel, they broke at the Top of the ſlender Part, and ſo never came to overflow. This done, the *Pump* was ſuffered to reſt a while, to give the *Aereal Particles*, lodged in the *Water*, Time to ſeparate themſelves and emerge: which when they had done a pretty while, the *Pump* was ply'd again, for fear ſome *Air* ſhould have ſtolen into ſo large a *Receiver*.

Theſe Viciſſitudes of *Pumping* and *Reſting* laſted for a conſiderable Time, till at length the *Bubbles* began to be very rare, and we weary of waiting any longer; ſoon after which, the external Air was let into the *Receiver*, and it appear'd ſomewhat ſtrange to the Spectators, that notwithſtanding ſo great a Multitude of *Bubbles* as had eſcaped out of the *Water*, I could not by attentively comparing the Place where the Surface of the *Water* reſted at firſt (to which a Mark had been affixed) with that where it now ſtood, I could not, I ſay, diſcern the Difference to amount to above, if ſo much as an Hair's breadth; and the chief Operator in the Experiment profeſſed, that for his part, he could not perceive any Difference at all.

6. Filling a Glaſs of the ſame *Shape*, and much of the ſame Bigneſs, with *Claret-Wine*, and placing it upon a convenient Pedeſtal, in a tall *Receiver*, we cauſed ſome of the Air to be pumped out: Whereupon in a ſhort Time there emerged thro' the ſlender Pipe ſo very great a Multitude of Bubbles, that were darted as it were upwards, as did not a little both pleaſe and ſurprize the Beholders: But it forced us to go warily to work, for fear the Glaſs ſhould break, or the *Wine* overflow. Wherefore we ſeaſonably left off pumping, before the *Receiver* was any thing near exhauſted, and ſuffered the *Bubbles* to get away as they could, till the preſent Danger was over-paſſed, and then from Time to Time we pumped a little more *Air* out of the *Receiver*, till we were weary; the withdrawing of a moderate Quantity of Air at a Time ſufficing, even at the latter End, to make the *Bubbles* not only copiouſly, but very ſwiftly aſcend, (by a *Minute-Watch*) for above a quarter of an Hour together.

Shell-Fiſhes. VI. 1. An *Oyſter* being put into a very ſmall *Receiver*, and kept in long enough to have ſucceſſively killed three or four Birds or Beaſts, &c. was not thereby killed, nor, for ought we could perceive, conſiderably diſturbed, only at each Suck we perceived, that the Air contained between the 2 *Shells* broke out at their Commiſſure; as we concluded from the Foam which at thoſe Times came forth all round that Commiſſure. About 24 Hours after, I found that both this and another that had been put into the *Receiver* at the ſame Time were alive.

2. We put a pretty large *Craw-fiſh* into a pretty large *Receiver*, and found that tho' he had been injur'd by a Fall before he was brought thither, yet he ſeemed not to be much incommoded by being included, till the Air was in great meaſure pumped out, and then its former Motion preſently ceas'd, and he lay as dead; till upon the letting in a little Air into the *Receiver*, he began forthwith to move afreſh; and upon the withdrawing the *Air* again, or preſently, as before, became moveleſs. Having repeated this Trial 2 or 3 Times, we took him out of the Receiver, where he appeared not to have ſuffered any Harm.

3. Having put an *Oyſter* into a Vial full of *Water*, before we included it in the *Receiver*, it proved ſo ſtrong as to keep itſelf cloſe ſhut, and repreſſed the *Eruption* of the *Bubbles* that in the other did force open the Shells from Time to Time, and kept in its own Air as long as we had occaſion to continue the Trials.

4. Moreover, a *Craw-fiſh*, that was thought more vigorous, being ſubſtituted in the Place of the former *Craw-fiſh*, tho' once he ſeemed to loſe his *Motion* together with the Air, yet afterwards he continued moving in the *Receiver*, in ſpite of our Pumping.

A Small Fiſh.

VII. We took a *Receiver* ſhaped almoſt like a *Bolt-head*, containing by Eſtimation near a *Pint*, and the *globulous* Part of it being almoſt half full of *Water*, we put into it, at the *Orifice* (which was pretty large) a ſmall *Gudgeon*, about 3 *Inches* long, which when it was in the *Water*, ſwam nimbly up and down therein. Then having drawn out the *Air* ſo well, that we gueſſed by a *Gage*, that about 19 Parts of 20 or more might be exhauſted, we ſecured ourſelves that the Regreſs of the *Air* ſhould not injure our Experiment; about which we obſerved that,

1. The Neck of the Glaſs being very long, though there appeared great Store of Bubbles all about the Fiſh; yet the reſt of the Water, notwithſtanding the withdrawing of ſo much *Air* as had been mentioned, emitted no Froth, and but few Bubbles.

2. The Fiſh both at his Mouth and Gills did, for a great while, diſcharge ſuch a Quantity of Bubbles as appear'd ſtrange, and for about half an Hour or more, (for much longer I had not Opportunity to watch it) whenever he reſted a while, new Bubbles would adhere to many Parts of his Body (as if they were generated there) eſpecially his Fins and Tail: So that he would appear almoſt beſet with *Bubbles*; and if, being excited to ſwim, he was made to ſhake them off, he would quickly, upon a little Reſt, be beſet with new ones as before.

3. Almoſt all the while he would gape and move his Gills, as before he was included; though towards the End of the Time that I watch'd, it often happened, that he neither took in, nor emitted any *Aereal* Particles that I could perceive.

4. After a while, he lay almoſt conſtantly with his Belly upwards, and yet would in that Poſture ſwim briskly as before.

5. Nay, after a while, he ſeemed to be more lively than at firſt putting in; whether by Reaſon, that by Diſcharge of ſo many Bubbles, which by their Diſtenſion,

ſenſion, perhaps, put him to Pain, he found himſelf relieved, or for ſome other Cauſe, I examine not.

6. About an Hour and an half after he had been ſealed up, I found him almoſt free from Bubbles, and with his Belly upwards, and ſeeming ſomewhat tumid, but yet lively as before. But an Hour and a quarter after that, he ſeemed to be moveleſs and ſomewhat ſtill; yet upon ſhaking the Glaſs, obſerving ſome faint Signs of Life in him by ſome languid Motions he attempted to make when excited to them, I opened the *Receiver* under *Water*, to try if that Liquor and Air would recover him; and the external *Water* ruſhing in, till it had filled the vacant Part of the Ball, and the greateſt Part of the Stem too, the Fiſh ſunk at the Bottom of it, with a greater Appearance than ever of being alive; in which State after he had continued a pretty while, I made a ſhift, by the Help of the *Water* he ſwam in, to get him through the Pipe into a Baſon of *Water*, where he gave more manifeſt Signs of Life; but yet for ſome *Hours* lay on one Side or other, without being able to ſwim or lie on his *Belly*, which appeared very much ſhrunk in, as if ſomething, during the Time of its being *ſealed* up, had been broken in his *Body*, or his *Belly* had been exceedingly diſtended, beyond Reſtitution of its former Tone.

All the while he continued in the Baſon of *Water*, though he moved his Gills as before he had been ſealed up; yet I could not perceive, that he did, even in his new *Water*, emit, as formerly, any *Bubbles*, though two or three Times I held him by the Tail in the *Air*, and put him into the *Water*, again, where at length he grew able to lie conſtantly upon his Belly, which yet retained much of its former Lankneſs. He lived in the Baſon 8 or 10 Days, though divers other *Gudgeons* died there in much fewer Days.

Wounded Animals.

VIII, 1. *Sept.* 12. A ſmall *Bird*, having the *Abdomen* opened almoſt from Flank to Flank, without injuring the *Guts*, was put into a ſmall *Receiver*, and the *Pump* being ſet a-work, continued for ſome Time without giving any Signs of Diſtreſs: But at the End of about a *Minute* and a *half* from the Beginning of the *Exhauſtion*, ſhe began to have *convulſive* Motions in the Wings; and though the *Convulſions* were not univerſal, nor did appear violent, as is uſual in other *Birds* from whom the Air is withdrawn by the Engine, yet at the End of two full *Minutes*, letting in the Air, and then taking off the *Receiver*, we found the *Bird* irrecoverable; notwithſtanding which, we did not find any notable Alteration in the *Lungs*, and found the *Heart* (or at leaſt the *Auricles* of it) to be yet beating, and ſo it continued for a while after.

2. We took alſo a pretty large *Frog*, and having, without violating the *Lungs* or the *Guts*, made two ſuch Inciſions in the *Abdomen*, that the two curl'd *Bladders* or *Lobes* of *Lungs* came out almoſt totally at them, we ſuſpended the *Frog* by the Legs in a ſmall *Receiver*, and after we had pumped out a good Part of the Air, the Animal ſtruggled very much, and ſeem'd to be much diſorder'd, and when the *Receiver* was well exhauſted, ſhe lay ſtill for a while as if ſhe had been dead, the *Abdomen* and Thigh very much ſwell'd, as if ſome *rarified Air* or Vapour forcibly diſtended them. But as, when the *Frog* was put in, one of the *Lobes* was almoſt full, and the other almoſt ſhrunk up,

ſo they continued to appear after the *Receiver* had been exhauſted; but upon letting in of the Air, not only the Body ceaſed to be tumid, but the plump Bladder appeared for a while ſhrunk up as the other, and the *Receiver* being removed, the *Frog* preſently *revived*, and quickly began to fill the *Lobe* again with Air.

The ſeparated Hearts of Cold Animals

IX. 1. The *Heart* of an *Eel* being taken out and laid upon a Plate of Tin in a ſmall *Receiver*, when we perceived it to beat there, as it had done in the open *Air*, we exhauſted the Veſſel, and ſaw, that though the *Heart* grew very tumid, and here and there ſent forth little Bubbles, yet it continued to beat as manifeſtly as before, and ſeem'd to do ſo more ſwiftly, as we tried by numbering the *Pulſations* it made in a *Minute*, whilſt it was in the exhauſted *Receiver*, and when we had re-admitted the *Air*, and alſo when we took it out of the Glaſs and ſuffered it to continue its Motion in the open *Air*.

2. The *Heart* of another *Eel*, after having been included in a *Receiver*, firſt *exhauſted*, and then accurately ſecur'd from leaking, though it appear'd very tumid, continued to beat there an Hour; after which looking upon it, and finding its Motion very languid, and almoſt ceas'd, by breathing a little upon that Part of the Glaſs where the Heart was, it quickly regained Motion, which I obſerv'd a while, and an *Hour* after finding it to ſeem almoſt quite gone, I was able to renew it by the Application of a little more Warmth.

At the End of the 3d *Hour* I could no more excite it by *Warmth*; wherefore I ſuffered the outward *Air* to ruſh in, but could not diſcern, that thereby the *Heart* regained any ſenſible Motion, though aſſiſted with the *Warmth* of my *Breath* and *Hands*.

Animals drowned *and deprived of* Air.

X. A ſufficient Number of Inſtances of *Animals* kill'd in the exhauſted *Receiver*, is to be met with in our other Experiments: And therefore I ſhall now ſubjoin ſome Trials, about the Times wherein Animals may be kill'd by that want of Reſpiration, which, in thoſe that are drowned, is cauſed by the *Water* that ſuffocates them.

1. *Sept.* 10. A *Green-Finch*, having his Legs and Wings tied to a Weight, was gently let down into a *Glaſs Body* fill'd with *Water*; and at the end of *half a Minute* he was found quite *Dead*.

2. A *Sparrow*, that was luſty and quarrelſome, was let down after the ſame Manner; but though he ſeemed to be under *Water* more vigorous than the other Bird, and continued ſtruggling almoſt to the very end of *half* a *Minute* from the Time of its being totally *Immerſed* (during which ſtay under *Water* there aſcended from Time to Time, pretty large *Bubbles* from his Mouth) yet notwithſtanding that as ſoon as ever the *half Minute* was completed he was drawn up, we found him, to our Wonder, *irrecoverably gone*.

3. A ſmall *Mouſe*, being held under *Water* by the Tail, emitted from Time to Time divers *Aereal Bubbles* out of his Mouth, and at laſt, as one of the Spectators affirmed he ſaw, at one of his Eyes. Being taken out at the end of half a Minute and ſome few Seconds, he yet retained ſome Motions; but they proved but convulſive ones, which at laſt ended in *Death*.

Vid. Sup. 1. Exp. 2.

4. We took the *Duck* mentioned above, and ſo tied a conſiderable Weight of Lead to her Body, as it did not hinder her Reſpiration, and yet

would be ſure to keep her down under Water. With this Clog ſhe was put into a Tub full of clear *Water*, under whoſe Surface ſhe continued about a Minute by my Watch quietly enough, but afterwards began to appear for a while much diſturbed; which Fit being over, our not perceiving any Motion in her, made us, at the end of the *ſecond Minute*, take her out of the *Water*, to ſee in what Condition ſhe was, and finding her in a good one, after we had allowed her ſome breathing Time to recruit herſelf with *freſh* Air, we let her down again into the Tub, which in the mean Time had been filled with *freſh Water*. After a while, ſhe began, and from Time to Time continued, to emit divers *Bubbles* at her Beak. There alſo came out at her Noſtrils divers real *Bubbles* from Time to Time; and when the Animal had continued about *two Minutes* or better under *Water*, ſhe began to ſtruggle very much, and to endeavour either to emerge, or change Poſtures; the latter of which ſhe had liberty to do, but not the former. After *four Minutes* the *Bubbles* came much more ſparingly from her: Then alſo ſhe began to gape from Time to Time, (which we had not obſerved her to do before) but without emitting *Bubbles*; and ſo ſhe continued gaping till near the End of the 6th *Minute*, at which Time all her Motions, ſome of which were judged *Convulſive*, and others that had been excited by our rouzing her with a *Forceps*, appear'd to ceaſe, and her Head to hang careleſly down as if ſhe were quite dead. Notwithſtanding which, we thought fit for greater Security to continue her under *Water* a full *Minute* longer, and then finding no Signs of Life, we took her out; and being hung by the Heels, and gently preſſed in convenient Places, ſhe was made to void a pretty Quantity of Water. But all the Means that were uſed to recover the Bird to Life, proving ineffectual, we concluded, ſhe had been dead a full *Minute* before we removed her out of the *Water*: So that to ſum up the Event of our *Experiment*, even this *Water-Bird* was not able to *live* in *cold Water*, without taking in *Freſh-Air*, above 6 *Minutes*.

Vid. Sup. 1. *Exp.* 2. 5. The *Duckling* (mentioned above) having a competent Weight ty'd to her Legs, was let down into a *Tub* of *Water*. There came out Store of *Bubbles* at her Noſtrils, but there ſeem'd to come out more and greater from a certain Place in her Head almoſt equi-diſtant from her Eyes, but ſomewhat leſs remote from her Neck than they. After much ſtruggling and frequent gaping, ſhe had divers *convulſive* Motions, and then let her Head fall down backward with her Throat upwards. To which moveleſs Poſture ſhe was reduced at the End of the *third Minute*, if not a little ſooner; but a while after there appeared a manifeſt but tremulous Motion in the two Parts of her Bill, which continued for ſome Time, but afforded no Circumſtances, whereby we could be ſure, that they were not *convulſive* Motions; but theſe alſo ceaſing upon the End of the *fourth Minute*, the Bird was taken out and found irrecoverable.

From theſe two Experiments it appears, that tho' *Water-Fowl* (at leaſt *Ducks*) could not in our *Receivers* endure the want of *Air* much longer than other *Birds*; yet by that Contrivance of Nature mentioned about the *Heart*, they are enabled to continue much longer under *Water*.

6. A *Viper* that was kept ſo many Hours in an *exhauſted Receiver* till it was concluded to be ſtark *dead*, and to have been ſo for a good while, was kept all Night in a Glaſs-Body upon a warm digeſtive Furnace. Whereupon the *Viper* was found, the next Morning, to be very *lively*. We then put her into a tall Glaſs-Body fitted with a Cork to the Orifice of it, and depreſſed with Weight, ſo that ſhe could come at no *Air*. And after ſhe had been *duck'd* a while, ſhe lay with a very little Motion for a conſiderable Space of Time. At an *Hour* and a *quarter* ſhe often put out her black Tongue; at near 4 *Hours* ſhe appear'd much *alive*, and, as I remember, about that Time alſo put out her Tongue, *ſwimming* all this while, as far as we obſerved, above the *Water*. At the end of about 7 *Hours* or more, ſhe ſeem'd yet to have ſome Life in her, her Poſture being manifeſtly changed in the Glaſs from what it was a while before, unleſs that might proceed from ſome Difference made in her Body as to Gravity and Levity. Not long after ſhe appeared quite dead; her Head and Tail hanging down moveleſly, and directly towards the Bottom of the Veſſel, whilſt the middle of the Body floated as much as the above-mentioned Cork would permit it.

I muſt here take notice, that though ſome of the above-mentioned Animals ſeem by the Relations we have given of them, to have been a little ſooner deſtroyed by *Drowning*, than any we have mentioned were by our *Engine*, yet that is no ſure Proof, that *Suffocation* does kill Animals faſter than the *Deprivation* of *Air*, they are expoſed to in our *Engine*. For in *Drowning*, that which deſtroys is applied to its full Vigour at the very firſt, and all at once; whereas our *Receivers*, being made for ſeveral Purpoſes, the *Deprivation* of the *Air*, that they make, cannot be made all at once, but the *Air* muſt be *pump'd* out by Degrees; ſo that till the laſt the *Receiver* will be but partly emptied. For Confirmation of which I have this to alledge, that, having in the Preſence of ſome *Virtuoſi*, provided for the nonce a very ſmall *Receiver*, wherein yet a *Mouſe* could live ſome Time if the *Air* were left in it, we were able to evacuate it at *one Suck*, and by that Advantage we were enabled, to the Wonder of the Beholders, to kill the Animal in leſs than *half a Minute*.

Animals in rarified Air, n. 63. p. 2036.

XI. 1. *Aug.* 16. A *Linnet* being put into a *Receiver*, capable to hold about four Pints and a half of *Water*, the Glaſs was well cloſed with Cement and a Cover; but none of the *Air* was drawn out with the *Engine*, or otherwiſe. And though no new Air was let in, nor any change made in the impriſoned Air, yet the *Bird* continued there 3 *Hours* without any apparent Approach to *Death*; and though it ſeemed ſomewhat *Sick*, yet being afterwards taken out it recovered, and lived ſeveral *Hours*.

2. *Aug.* 18. From the above-mentioned *Receiver* about *half* the *Air* was drawn out, a *Linnet* being then in the Glaſs, and in the *rarified Air* (which appear'd by a *Gage* to continue in that State) the *Bird* lived an *Hour* and near a *quarter* before it ſeem'd in Danger of *Death*; after which the *Air* being let in without taking off the *Receiver*, ſhe manifeſtly recovered, and leap'd againſt the Side of the Glaſs; being taken out into the *open Air*, ſhe flew out of my Hand to a pretty Diſtance.

3. *Sept.* 9. We conveyed into a *Receiver*, capable to hold about 4 ½ *Pints* of Water, a *Lark*, together with the *Gage*, by the Help whereof we pump'd out of the *Receiver* ¾ of the *Air* that was in it before; then heedfully obſerving the *Bird*, we perceived it to pant very much, ſo that a learned Phyſician (from whom I yet diſſented) judged theſe Beatings to be *Convulſive*: Having continued thus for a little above a *Minute* and a half, the *Bird* fell into a true *convulſive* Motion, that caſt it upon the Back. And although we made great haſte to let in the *Air*, yet before the Expiration of the *ſecond Minute*, and conſequently in leſs than *half* a *Minute* from the Time immediately preceding the *Convulſion*, the *Lark* was gone paſt all Recovery.

4. Preſently after we put into the ſame *Receiver* a *Green-finch*, and having withdrawn the *Air*, till it appeared by the *Gage* there remained but *half*, we took notice, that, within a *Minute* after, ſhe appeared to be very *ſick*, and ſhaking her Head, threw againſt the inſide of the Glaſs a certain Subſtance, which I took to be Vomit, and which afterwards appeared ſo; upon this *Evacuation* the *Bird* ſeemed to recover, and continue pretty well (but not without panting) till about the end of the 4th *Minute*, at which growing very *ſick*, ſhe vomited again (ſhaking her Head as at firſt,) but much more unqueſtionably than before, and ſoon after, eat up again a little of her Vomit: At which Time (whether that contributed to her Recovery or no) ſhe very much recovered. And though ſhe had, in all, three Fits of Vomiting, yet for the laſt 7 or 8 *Minutes* that we kept her in the *Receiver* ſhe ſeemed to be much more *lively* than was expected: Which may in Part be attributed to a little *Air* that by an Accident got in, tho' it were immediately *pump'd* out again. At the end of a full *quarter* of an *Hour* from the firſt Exhauſtion of the *Receiver*, the Bird appearing little likely to die in a while, we took her out.

5. *April* 12. A *Viper* was included, together with a *Gage*, in a portable *Receiver*, capable to hold 3 ½ *Pints* of Water. The Veſſel being exhauſted, and ſecured againſt the Regreſs of the *Air*, the impriſoned Animal was obſerv'd not only to be alive, but nimbly to put out and to draw back its Tongue, about 36 *Hours* after it was firſt ſhut up. At the end of 60 *Hours*, as I was going to Bed, ſhe appear'd very dull and faint, and not likely to live much longer; the next Day after *Dinner*, I found her ſtark *dead*, with her Mouth open'd to a ſtrange Wideneſs: Wherefore ſuffering *Water* to be impelled by the outward *Air* into the Cavity of the *Receiver*, we found that 4 Parts of 5, or rather 5 of 6 of the veſſelled *Air* had been pumped out.

Difficult Reſpiration at the Tops of Mountains.

6. I ſhall here add, that, an eccleſiaſtical Perſon, who had viſited thoſe *high Mountains* of *Armenia* (on one of which, becauſe of their Height, the Tradition of the Natives will needs have the *Ark* to have reſted;) told me, that thoſe *Mountains* were really exceeding *high*, and that he could not come to the *Top*, (becauſe of the unpaſſable Snows) And that whilſt he was in the upper Part of the *Mountain*, he plainly perceived that he was reduced to fetch his Breath much oftner than he was wont, and than he did before he aſcended the Hill, and after he came down from it; and that having expreſt ſome Wonder to find himſelf ſo ſhort-winded, the People told him, that it was no more than

happened to them when they were ſo high above the Plain; it being a common Obſervation among them. He alſo told me, that he made the like Obſervation upon the *Top* of a Mountain in the Country of *Sevennes*, in or near the Province of *Languedoc*.

A learned Traveller, who was a Perſon very Curious and Intelligent, told me, that being invited, about the beginning of *September*, to viſit a neighbouring Mountain that is at leaſt one of the *higheſt* of the *Pyreneans*, which is commonly call'd *Pic de Midi*, they found the *Air* there not ſo fit for *Reſpiration* as common *Air*, and were fain to breath *ſhorter* and *oftner* than uſual; and becauſe I ſuſpected, that might come from their Motion, I asked whether they obſerved it to ceaſe when they came down to the *Bottom* of the *Hill*, which he told me they plainly did; beſides that, they ſtaid many *Hours* at the *Top*, too long to continue out of *Breath*.

It is worth farther Inquiry, whether the Sickneſs, if not alſo the Difficulty of Breathing that ſome have been obnoxious to in the uppermoſt Parts of *Pariacbaca*, and perhaps ſome other *high Mountains*, may not be imputed, not ſo preciſely to the *Thinneſs* and *Rarity* of the *Air*, in Places ſo remote from the lowermoſt Part of the *Atmoſphere*, as to exclude certain *Steams* of a peculiar Nature, which in ſome Places the *Air* may be imbued with. For an intelligent Perſon informed me, that he had attempted to go up to the *Top* of the *Pic* of *Teneriffe*: But that, though ſome of the Company were able to do ſo, he and ſome others, before they had reached near ſo *high*, grew ſo *ſick* upon the Operation they felt of the ſharp *Air*, and *ſulphurous Exhalations* which infected it, that they were fain to ſtay behind their Companions, he having already found this Effect of thoſe *piercing Steams* upon his Face, that the *Skin* began to be of a *Pale-yellow*, and even his *Hair* to be diſcoloured.

Animals in the ſame Air *varied as to* Denſity.

XII. We included a *Mouſe* in a fine limber and clear *Bladder*, made more tranſparent by being anointed with *Oyl* on the outſide, that the Smell of it might leſs offend him.

Then, to make up ſo large an Orifice without Wrinkles, (at which the *rarified Air* may eſcape) we provided a round Stick, ſomewhat leſs than the Orifice, which we laid over with a cloſe and yielding Cement, (for Pitch, or the like uncommon Stuff, will not always ſerve the Turn) and ty'd the *Bladder* faſt and cloſe enough upon it, leaving in the *Bladder* as much *Air* as we thought might ſuffice him for as long Time as the *Experiment* was to laſt. Then putting this limber or *extenſible Receiver*, if I may ſo call it, into an ordinary one of Glaſs, and placing this *Engine* near a Window, that we might ſee through both of them; the *Air* was by Degrees pump'd out of the *external Receiver*, (as for Diſtinction ſake I ſhall call it,) and thereupon the *Air* included in the *Bladder* did proportionally expand itſelf, and ſo diſtend the *internal Receiver*, till being arrived at a Degree of *Rarefaction*, which rendred it unfit for the included *Mouſe's Reſpiration*, I perceived, though with ſome Difficulty, in this Animal, the Signs of his being in great Danger of *ſudden Death*. Whereupon the outward *Air*, being haſtily let into the *external Receiver*, compreſſed the ſwelled *Bladder* to its former Dimenſions, and thereby the *included Air* to its former *Denſity*, by which means the *fainting Mouſe* was quickly *revived*. Having given him ſome convenient Time of Reſpite, the *Experiment* was reiterated with the like Succeſs; and we doubted not but the *third Trial* we made, would have ended as the two former did: But whilſt we were conſidering of the Sickneſs of the *Mouſe*, which, by Reaſon of ſome Opacity that would ſcarce be avoided in the wrinkled Bladder, was not, as to its Degree, ſo eaſily taken notice of, it grew *irrecoverable* by the ſubſequent *Condenſation* of the *Air*.

The Production and Growth of Animals in an exhauſted Receiver.

XIII. 1. We took a good Company of *Tadpoles*, and put them with a convenient *Quantity* of *Water* into a portable *Receiver* of a round Figure, and obſerv'd, that at the firſt *Exſuction* of the *Air*, they did riſe to the Top of the Water, though moſt of them ſubſided again, till the next *Exſuction* raiſed them. They ſeem'd by their active and wrigling Motion to be very diſcompoſed. The *Receiver* being *exhauſted*, they continued reſtleſs, moving all of them on the Top of the Water; and tho' ſome of them ſeemed to endeavour to go to the Bottom, and dived ſome Part of the Way, eſpecially with their Heads, yet they were immediately buoyed up again. Within an *Hour* or a little more they were all moveleſs, and lay floating on the Water; wherefore I opened the *Receiver*, upon which the *Air* ruſhed in, and almoſt all of them (which were many) preſently ſunk to the Bottom, but none of them recovered to *Life*.

2. A little after theſe, we included a leſſer Number of *Tadpoles* in a ſmaller Glaſs, which was alſo *exhauſted* with the like Circumſtances with the former. And when I found the other *Tadpoles* to be *dead*, I haſted to theſe, which did not, except perhaps one, give any Sign of *Life*; but upon letting in the *Air*, theſe having not been long kept from it, ſome few of them did recover, and ſwam up and down lively enough for ſome Time; though after a while they alſo *dy'd*.

3. Some Years after, I repeated the ſame *Experiment*: And though after the *Exhauſtion* was perfected, the *Tadpoles* did for a while move briſkly enough on the Top of the *Water*, (none of them appearing able to Dive or Swim under *Water*) yet coming to look on them after the End of an *Hour*, they ſeem'd to be all of them quite dead, yet continued floating. And though within *half* an *Hour* after that, I let in the *Air* upon them, yet all the Effect of it was, that moſt of them immediately ſunk to the Bottom, as the reſt of them did a very little while after; none of them, that I could obſerve, recovering any *vital Motion*.

4. Having after much watching and with much ado got 4 or 5 of thoſe odd *Aquatick Inſects* whereof *Gnats* are generated, about the End of *Auguſt*, after a Shower of *Rain* which dropt from a Houſe into a Veſſel laid on Purpoſe for it, we included them, with ſome of their *Water*, into a ſmall Glaſs *Receiver*, which being very exactly cloſed, we kept in a South-Window, where thoſe little Creatures continued to ſwim up and down for ſome few *Days*, without ſeeming to be much incommoded by ſo unuſual an Habitation; and at the End of that Time, and much about the ſame Day, they diveſted the Habit they had whilſt they lived as *Fiſhes*, and appear'd with their *Exuviæ*, or caſt Coats, under their Feet, ſhewing themſelves to be per-

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ſect *Gnats*, that ſtood without ſinking upon the Surface of the *Water*, and diſcovered themſelves to be *alive* by their Motion, when they were excited to it: But I could not perceive them to *fly* in that *thin Medium*; to which Inability, whether the *Viſcoſity* of the *Water* might contribute, I know not, though they lived a pretty while, till Hunger or Cold deſtroy'd them.

The Expanſion of Blood and other Animal Juices, *and of the* Soft Parts *of the Body*,

1. The warm *Blood* of a Lamb, or a *Sheep*, being taken as it were haſtily brought from the Butchers, where the Fibres had been broken to hinder the *Coagulation*, was in a wide-mouth'd Glaſs put into a *Receiver*, made ready for it, and the *Pump* being early ſet on Work, the *Air* was diligently drawn out. After a long Expectation, the more ſubtile Parts of the *Blood* would begin to force their Way through the more clammy ones, and ſeem to boil in large Cluſters, ſome as big as great Beans or Nutmegs; and ſometimes to the Wonder of the by-ſtanding Phyſicians, the *Blood* was ſo volatile, and the Expanſion ſo vehement, that it boiled over the containing Glaſs; of which, when it was put in, it did not, by our Eſtimate, fill above a Quarter.

Having alſo included ſome *Milk*, warm from the Cow, in a cylindrical Veſſel of about 4 or 5 Inches high, when the *external Air* was *fully* withdrawn, the white Liquor began to boil in a way that was not ſo eaſy to deſcribe, as pleaſant to behold: And this it did for a pretty while, with ſo much Impetuoſity, that it threw up ſeveral Parts of itſelf out of the wide-mouthed Glaſs that contained it (and could have contained as much more) though there were not above two or three *Ounces* of the Liquor.

A yet greater Diſpoſition to the *Intumeſcence* we thought we obſerv'd in the *Gall*, which was but ſuitable to the *Viſcoſity* of the Texture.

Note, That the two foregoing Experiments were made with an Eye caſt upon the Inquiry, that I thought might be made, Whether, and how far the deſtructive Operation of our *Engine* upon the included Animal, might be imputed to this, that upon the withdrawing of the *Air*, beſides the Removal of what the *Air*'s Preſence contributes to Life, the little *Bubbles* generated upon the Abſence of the Air in the Blood, Juices, and ſoft Parts of the Body, may by their vaſt Number and their conſpiring Diſtenſions, variouſly ſtreighten in ſome Places, and ſtretch in others, the Veſſels, eſpecially the ſmaller ones, that convey the Blood and Nouriſhment; and ſo by choaking up ſome Paſſages, and vitiating the Figure of others, diſturb, or hinder the due Circulation of the Blood: not to mention the Pains that ſuch Diſtenſions may cauſe in ſome Nerves and membranous Parts, which by irritating ſome of them into Convulſions, may haſten the Death of Animals, and deſtroy them ſooner by occaſion of that Irritation, than they would be deſtroyed by the bare Abſence, or Loſs of what the Air is neceſſary to ſupply them with. And to ſhew, how this Production of Bubbles reaches even to very minute Parts of the Body, I ſhall add on this occaſion (hoping that I have not prevented myſelf on any other) what may ſeem ſomewhat ſtrange, what I once obſerved in a *Viper*, furiouſly tortured in our exhauſted Receiver, namely, that it had manifeſtly a conſpicuous Bubble moving to and fro in the wateriſh Humour of one of its Eyes.

2. And to ſhew, that not only the Blood and Liquors, but alſo the other ſoft Parts, even in cold *Animals*, have aereal Particles latitant in them, we took the *Liver* and *Heart* of an *Eel*, as alſo the *Head* and *Body* of another *Fiſh* of the ſame Kind, cut aſunder croſs-ways ſomewhat beneath the *Heart*, and putting them into a *Receiver*, upon the withdrawing of the *Air*, we perceived that the *Liver* did manifeſtly ſwell every way, and that both the upper and lower Parts did ſo likewiſe; and at the place where the Diviſion had been made there came out, in each Portion of the *Fiſh*, diverſe *Bubbles*, ſeveral of which ſeem'd to come from the *Medulla Spinalis*, or the Cavity of the *Back-bone*, or the adjoining Parts, and the external Air being let in, both the Portions of the *Eel* preſently ſhrunk, ſome of the Skin ſeeming to be grown empty or flaccid in each of them.

Aſſuefaction to rarified Air.

XIV. 1. We included in a round Vial with a wide Neck, (the whole *Glaſs* being capable of containing about 8 Ounces of *Water*) a young and ſmall *Mouſe*, and then tied ſtrongly upon the upper Part of the *Glaſs*'s Neck a fine thin *Bladder*, out of which the *Air* had been carefully expreſſed, and then conveyed this phantaſtical Veſſel into a middle-ſized *Receiver*, in which we alſo placed a *mercurial Gage*. The *Air* was by Degrees pumped out, till it appeared by the *Gage* that there remained but a 4th Part in the *external Receiver*, (as for Diſtinction ſake I call it;) whereupon the *Air* in the *external Receiver* expanding itſelf, appeared for to have blown the *Bladder* almoſt half full, and the *Mouſe* ſeemed very ill at Eaſe by his leaping, and otherwiſe endeavouring to paſs out at the Neck of his uneaſy Priſon; we did, for fear the over-thin Air would diſpatch him, let the Air flow into the *external Receiver*, whereby the *Bladder* being compreſs'd, and the *Air* in the Vial reduced to its former *Denſity*, the little Animal quickly recovered.

2. A while after, without removing the *Bladder*, the *Experiment* was repeated, and the *Air*, by the help of the *Gage*, was reduced to its former Degree of *Rarefaction*; and the *Mouſe* was kept in that thin Air for full 4 *Minutes*; at the End of which he appeared ſo ſick, that to prevent his dying immediately, we removed the *external*, and took out the *internal Receiver*. Whereupon, tho' he recovered, yet 'twas not without much Difficulty; being unable to ſtand any longer upon his Feet, and for a great while after continued manifeſtly trembling.

3. But having ſuffered him to reſt a ſeaſonable Space of Time, preſuming that *Aſſuefaction* had accuſtomed him to greater Hardſhips, we conveyed him again into the *external Receiver*, and having brought the *Air* to the former Degree of *Expanſion*, we were able to keep him there for a full quarter of an Hour. And 'tis worth noting, That till near the latter End of the quarter of an Hour, not only the *Animal* did ſcarce at all appear diſtreſſed, remaining ſtill very quiet; but which is more, whereas when he was put in, the Tremblings formerly mention'd were yet upon him, and continued ſo for ſome Time, yet afterwards, in ſpight of the *Expanſion* of the *Air* he was then in, they left him early enough. And when the *internal Receiver* was taken out, he did not only recover from his fainting Fit ſooner than before, but eſcaped thoſe ſubſequent Tremblings.

4. After we had allow'd him ſome Time to recollect his Strength, we re-convey'd him into the *Receiver*, and pump'd out the *Air*, till the *Mercury* in the *Gage* was not only drawn down as low as formerly, but near half an Inch lower. And tho' this did at firſt ſeem to diſcompoſe our little Beaſt, yet after a-while he grew very quiet, and continued ſo for a full quarter of an Hour, when we cauſed 3 *Exſuctions* more to be made by the Pump, before we diſcovered him to be in manifeſt Danger (at which Time the *Bladder* appear'd much fuller than before:) But then we were oblig'd to let the *Air* into the outward *Receiver*, whereupon the *Mouſe* was more ſpeedily revived than one would have ſuſpected.

And theſe *Trials* of the Power of *Aſſuefaction* ſeem'd the more conſiderable, becauſe the *Air* in which the *Mouſe* had all this while lived, had been clogged and infected with the *excrementitious Effluviums* of his Body; for 'twas the ſame all along, we having purpoſely forborn to take off the *Bladder*.

Unfit for Reſpiration, *yet* retaining *its* Denſity.

XV. 1. We took a *Mouſe* of an ordinary Size, and having, not without ſome Difficulty, conveyed him into an oval Glaſs fitted with a ſomewhat long and conſiderably broad Neck, we conveyed in after him a *Mercurial Gage*, in which we had diligently obſerved and marked the Station of the *Mercury*, and which was ſo faſtned to a *Wire* reaching to the Bottom of the *Oval Glaſs*, that the *Gage* remaining in the *Neck*, was not in Danger to be broken by the Motions of the *Mouſe* in the oval Part: The upper Part of the long Neck of the Glaſs was, notwithſtanding the Wideneſs of it, *hermetically ſeal'd*: And tho' by Reaſon of the Largeneſs of the Veſſel in Compariſon of ſo ſmall an Animal, he ſeem'd to me rather drooping than very near Death at the End of the *ſecond Hour*; yet coming to look upon him about *half* an *Hour* after, he was judg'd by the Spectators quite dead, notwithſtanding our ſhaking of the Veſſel to rouze him up. This made me caſt my Eyes upon the *Gage*, wherein I could not perceive any ſenſible Change of the *Mercury*'s Station. But having cauſed the ſeal'd Part of the Glaſs to be broken off, and freſh *Air* to be blown in by a pair of Bellows, the gaſping Animal revived, tho' but ſlowly.

2. Such an Experiment as the former we made with like Succeſs upon a ſmall Bird, included with a *Gage* in a *Receiver*, holding about a Quart of Water. The *Bird* in about half an Hour appeared to be ſick and drooping, and the Faintneſs and Difficulty of *Breathing* increaſed for about 2 Hours and an half after that, at which Time the Animal died, the *Gage* being not ſenſibly altered.

3. In a *Glaſs Vial*, capacious enough to hold about 3 Quarts of *Water*, we *hermetically* ſealed up a ſmall Bird, and found, that in a few *Minutes* he began to be ſick and pant; which *Symptoms* I ſuffered to continue and increaſe againſt the Mind of a learned *By-ſtander*, who thought the Animal would not hold out ſo long, till they had laſted juſt half an Hour; at which Time having provided a Veſſel of *Water*, made exceeding cold with *Sal-Armoniack*, newly put into it, the *Vial* with the ſick *Bird* was immerſed in it, and kept there in that Condition for 6 Minutes; and yet it did not appear, that this great *Refrigeration* did ſenſibly refreſh the drooping Animal. So that this Remedy proving ineffectual, the *Vial* was removed out of the *Water*, and the *Bird*

ſome time after did, as I foretold, make many Strains to vomit, (tho' ſhe brought up little) followed by *Evacuations* downward, before ſhe quite expired, which ſhe did within a Minute or two of a juſt Hour after the Beginning of her Impriſonment.

The uſe of Air in Reſpiration.

XVI. We made by *Diſtillation* a Blood-red Liquor, which I have with very little variation communicated in the *Hiſtory* of *Colours*, and which chiefly conſiſts of ſuch *ſaline* and *ſpirituous* Particles as may be obtained from the *Maſs* of *Blood* in human Bodies. This *Liquor* is of ſuch a Nature, that if a *Glaſs-Vial*, about half fill'd with it, be kept well ſtopp'd, the red Liquor will reſt as quietly as any ordinary one, without ſending up any Smoke or viſible Exhalation; but if the *Vial* be unſtopped, ſo that the *external Air* be permitted to come in and touch the Surface of the Liquor, within a quarter of a Minute or leſs, there will upon this Contact be elevated a copious white Smoke, which will not only fill the upper Part of the Glaſs, but plentifully paſs out into the open Air, till the *Vial* be again ſtopped. This *Experiment* may ſerve to illuſtrate the Office of the *Air* to carry off in *Expiration* the *fuliginous Steams* of the *Lungs*. For, in our Experiment we manifeſtly ſee, that the very *Contact* of the *Air* may give the *Corpuſcles* of moiſt Bodies a peculiar Volatility, or Facility to emerge in the Form of *Steams*. It may here ſuffice to take notice of theſe two Things: The one is, that when the *Vial* has lain ſtopped and quiet a competent Time, the upper Half of it will appear deſtitute of *Fumes*, of which the *Air*, it ſeems, will imbibe, and conſtantly retain but a certain moderate Quantity; which may give ſome Light towards the Reaſon, why the ſame *Air*, which will be quite clogged with *Steams*, will not long ſerve for *Reſpiration*, which requires frequent Supplies of freſh *Air*: The other is, That if the *unſtopped Vial* were placed in our *Vacuum*, it would not emit any viſible Steams at all, nor ſo much as to appear in the upper Part of the Glaſs itſelf that held the Liquor; whereas, when the Air was by degrees reſtored at the *Stopcock* without moving the *Receiver* itſelf, to avoid injuring its Cloſeneſs, the returning Air would preſently raiſe the *Fumes*, firſt into the vacant Part of the *Vial*, whence they would aſcend into the Capacity of the *Receiver*; and likewiſe, when the Air that was requiſite to ſupport them was pumped out, they alſo accompanied it, as their unpleaſant Smell evinced, and the red Spirit, tho' it remain'd unſtopped, emitted no more *Fumes* till the Air was let in.

Snails, Efts, and Leeches.

XVII. 1. Two *white Snails without Shells*, of differing Sizes, (the biggeſt about an Inch and a half, and the other about an Inch in Length) were included in a ſmall portable *Receiver*, which was carefully *exhauſted*, and ſecured againſt the Return of the *Air*. Preſently after 'twas remov'd from the *Engine*, it was eaſy to diſcern that both the *Snails* thruſt out and retracted their Horns (as they are commonly call'd) at pleaſure, tho' their Bodies had in the ſofter Places pretty Store of newly generated *Bubbles* ſticking to them: But tho' they did not loſe their Motion near ſo ſoon, as other *Animals* were in our *Vacuum* wont to do, yet coming to look on them after ſome Hours, they appeared moveleſs and very tumid, and at the End of 12 *Hours*, the inward Parts of their Bodies ſeemed to be almoſt vaniſhed, and they ſeemed to be but a couple of ſmall full-blown Bladders; and on the letting in of the Air, they immediately ſo ſhrunk, as if the Bladders having been pricked, the reſiding Air had left behind it nothing but Skins; nor did either of the *Snails* afterwards, tho' kept many Hours, give any Signs of Life.

2. We included in a *Receiver*, whoſe globular Part was about the Bigneſs of a large *Orange*, one of that Sort of *Animals* that they vulgarly call *Efts*: Having withdrawn, but not ſolicitouſly, the Air, we kept him there about 48 Hours: During all which Time he continued alive, but appeared ſomewhat *ſwelled* in his Belly; his under-chap moving the very firſt Night, but not the Day and Night following. By opening the *Receiver* at length under Water, we perceived, that about half the Air had been drawn out. As ſoon as the Water was impelled into the Glaſs, the *Animal* that was before dull and torpid, ſeem'd, by very nimble and extravagant Motions, to be ſtrangely revived.

3. We took a *Leech*, that was of a moderate Bigneſs, or ſomewhat ſhort of it, and having included it together with ſome *Water* in a portable *Receiver*, that was gueſs'd to be capable of holding about ten or 12 *Ounces* of that Liquor, the *Air* was pump'd out after the uſual Manner, and the *Receiver* being remov'd to a lightſome Place, we obſerved, as we expected, that the *Leech* keeping herſelf under Water, there emerged from diverſe Parts of her Body ſtore of *Bubbles*, ſome of them in a diſperſed Way, but others in *Rows* or *Files*, if I may ſo ſpeak, that ſeem'd to come from determinate Points. Though this Production of *Bubbles* laſted a pretty while, yet the *Leech* did not ſeem to be very much *diſcompoſed* by her preſent Condition: For after 5 Days (tho' the *Receiver* continued well exhauſted) we found her very lively.

Creeping Inſects.

XVIII. 1. We took 5 or 6 *Caterpillars* of the ſame Sort; and had the *Air* drawn from them, and carefully kept from returning. About an Hour after, I found them moving to and fro in the *Receiver*, and even above two Hours after that, I could by ſhaking the Veſſel, excite in them ſome Motions, that I did not ſuſpect to be convulſive. But about 10 Hours after they were firſt included, they ſeem'd to be quite dead; yet the *Air* being forthwith reſtored to them, I found the next *Day*, that 3 or 4 of them were perfectly alive.

2. We took from a Hedge a Branch that had a large *Cobweb* of *Caterpillars* in it, and having divided it into two Parts, we put them into like *Receivers*; and in one of them ſhut up the *Caterpillars* together with the *Air*, which from the other was exhauſted. The Event was, that in that which had the *Air*, the little and difficultly viſible *Inſects*, after a ſmall Time appeared to move up and down as before, and ſo continued to do for a Day or *two*; whereas that Glaſs whence the *Air* had been drawn out, and continued kept out, ſhewed, after a very little while, no Motion that we could perceive.

Winged Inſects.

XIX. 1. *Nov.* 12. 8 *at Night.* There were taken 4 middle-ſiz'd *Fleſh-flies*, which having their Heads cut off, were incloſed in a portable *Receiver*, furniſhed with a pretty large Pipe and a Bubble at the End. As ſoon as the *Receiver* was exhauſted, thoſe *Flies* loſt their Motion (which was not briſk before.) An *Hour* or *two* after, I approached them to the Fire, which reſtored not their Motion to them (but as to one of them I ſuſpected it had a languid Motion for a while) wherefore I let in the Air upon them, after which in a

very

very ſhort Time, tho' not immediately, they began one after another to move their Legs, and *one* or *two* of them to walk.

2. *Sept.* 11. *About Noon.* We cloſed up divers ordinary *Flies*, and a *Bee* or *Waſp*; all which, when the *Air* was fully *withdrawn*, lay as dead, ſave that for a very *few Minutes* ſome of them had convulſive Motions in their Legs; they continued in this State 48 Hours, after which, the *Air* was let in upon them, but none of them recovered.

3. *Decem.* 11. at Night, we put a great *Fleſh-Fly* into a very ſmall portable *Receiver*, where at firſt it appear'd to be very brisk and lively, but as ſoon as the *Air* was *drawn* out, fell on her Back, and ſeemed to have convulſive Motions in her Feet and *Proboſcis*, from whence ſhe preſently recover'd, upon the letting in of the *Air*; which being *drawn* out again, ſhe lay as dead; but a while after, (within a quarter or half an Hour) I perceived, that upon ſhaking the *Receiver*, ſhe ſtirred up and down, but faintly. The next Night, by Warmth, and letting in the *Air*, the *Fly* recovered: But being next Morning *ſeal'd up* again in that Glaſs, and kept 48 Hours, tho' over the Chimney, ſhe died for good and all.

4. We took a large *Graſhopper*, whoſe Body, beſides the Horns and Limbs, was about an Inch in Length, and of a great Thickneſs in Proportion to that Length: This we conveyed into a portable *Receiver* of an oval Form, and capable of holding, by our Gueſs, about a Pint of *Water*. When the *Air* began to be conſiderably rarified, he appeared to be very ill at Eaſe, and ſeemed to ſweat out of the *Abdomen* many little Drops of Liquor, which being united, trickled down the Glaſs like a little Stream, which made at the Bottom a ſmall Pool of clear Liquor, amounting to near a *Quarter* of a *Spoonful*; and by that time the *Receiver* was ready to be taken off, the *Graſs-hopper*, was fallen upon his Back, and lay as dead, and continued ſo for 3 *Hours*; after which, the *Air* being let in upon him, he continued without any Signs of Life for a Quarter or Half an *Hour*: But being carried into a Sun-ſhiny Place, the Beams of a declining Sun preſently began to make him ſtir his *Limbs*, and in a ſhort time brought him perfectly to Life again.

5. *Apr.* 15. We took one of thoſe *ſhining Beetles* they call *Roſe-Flies*, and included it in a very ſmall round *Receiver*, which we *exhauſted*; and tho' it ſtruggled much whilſt the *Air* was withdrawing, yet preſently after, I could perceive but little Motion (and part of that ſeemed almoſt convulſive.) About ſix Hours after, it ſeem'd quite dead, and upon the Return of the Air, no Sign of Life enſued for a pretty while; but 3 or 4 Hours after, I found him lively enough.

6. Having obſerved *Butterflies* not only to *live*, but to *move* longer than was expected, I included divers of them in ſomewhat large *Receivers*, and tho' whilſt the *Air* continued in the *Glaſſes*, they *flew* actively as well as freely up and down; and tho' after the *Exhauſtion* of the *Air* they continued to live, and were not moveleſs; nay, tho' at the Bottom of the *Receiver*, they would even move their Wings, and a little flutter: Yet I could not perceive any of them to fly, by which I mean, perform any progreſſive Motion ſupported by the Medium only. And by frequently inverting the

Receiver (which I took Care ſhould be pretty long, to let them fall from one Extream to the other) they would fall like dead Animals, without diſplaying their Wings; tho' juſt as they came to touch the Bottom, ſome of them would ſometimes ſeem to make ſome Uſe of them, but not enough to ſuſtain themſelves, or to keep their Falls from being rude enough.

Ants and Mites.

XX. 1. A pretty Number of *Ants* were included in a ſmall portable *Receiver*, exhauſted yeſterday about Noon. They grew almoſt moveleſs as ſoon as the Air was exhauſted: And between 6 and 7 in the Afternoon, they ſeem'd to be all quite dead. Whereupon I opened the Glaſs, and tho' no Sign of Life appear'd for a great while, yet this Morning I found many of them alive, and moving to and fro.

2. We conveyed a pretty Number of *Mites*, which are reputed but living Points, together with the mouldy Cheeſe they were bred in, to nouriſh them, into 3 or 4 very ſmall *Receivers*. One of them with the Air in it was ſeal'd up at a Lamp Furnace, and from all the reſt we *withdrew* the Air. This done, we obſerv'd the following *Phænomena*, viz.

1. Thoſe *Mites* that were incloſed in the ſmall Glaſs that never came near the Engine, continued alive, and able to walk up and down for above a full Week, after they had been put in; and poſſibly would have continued much longer, if the Glaſs had not been broken.

2. Though juſt before the *withdrawing* of the *Air*, the *Mites* were ſeen to move up and down in it; yet within a few *Minutes* after the *Receiver* was applied to the Engine, I could diſcern in them no Life at all, tho' my Eye was aſſiſted with a double convex Glaſs. Above an Hour after, I could not perceive any of them to ſtir: 2 or 3 Hours after that, I let in the Air, and left the *Receiver* unſtopped in a *Window*.

3. About 2 or 3 Days after, I found a Number of my little Animals revived, as an attentive Eye might eaſily perceive by the Motion of certain little white Specks; and they continued to appear alive for 2 or 3 Days after that, if not longer.

4. One of the *Receivers* was kept exhauſted from *Monday* to *Tueſday*; after all which time, our attentive Eyes being unable to diſcover any Signs of Life among the included Mites, the Air was let in upon them, and after a long time, we could plainly ſee them creep up and down in the Glaſſes again.

Experiments *about the* Weakned Spring, *and ſome unobſerved* Effects *of the* Air, *by* Mr. Rob. Boyle, n. 120. p. 467.

LXXVIII. 1. We took Filings of crude *Copper*, and put them into a cryſtalline Glaſs of a conical Shape, into which we poured ſome ſtrong Spirit of *Salt*, (that was fitted for our peculiar Purpoſe) to the Height of about a Finger's breadth above the *Filings*, and then cloſing the Veſſel with a Glaſs-ſtopple, exquiſitely fitted to it, we ſuffered it to continue unmoved in a *Window* for ſome Days, till the Liquor had both obtained a high and darkiſh brown Colour, by the Solution of ſome of the *Copper*, and loſt that Colour again, growing clear like common Water (which is itſelf a ſomewhat odd *Phænomenon*,) and then taking out the Stopple, without ſhaking the Liquor, and thereby giving Acceſs to the *outward Air*, we perceived, as we had conjectured, that the upper Surface of the Liquor did in a *few Minutes* re-acquire a darkiſh *brown* Colour, which penetrating deeper and deeper, at the End of about a Quarter of an Hour, the whole Body of the Liquor appeared to be likewiſe tinged. The conical Glaſs being again well ſtopp'd, the *Menſtruum* did again in very few Days let fall, or otherwiſe loſe its *Tincture*, which, the Stopple being taken out, it regained as before. Nor were theſe 2 the only Trials I made with the like Succeſs for the main; but afterwards being deſirous by a farther Trial to reſolve a Doubt I had, I kept the Glaſs yet longer in the ſame Place with the ſame *Filings* and *Menſtruum* in it, for, if I miſremember not, a *Month* or *two* together; but obſerved not that the Liquor would any more grow clear.

2. Having taken another conical Glaſs, wherein the Liquor was grown clearer than is uſual, and had probably been ſo a good while before, for the Veſſel having been hid by others which ſtood before it, had been for ſome Weeks forgotten; we took out the Stopple, and left it out for about half an Hour, but did not perceive the Liquor to have acquired any Colour, ſo much as at the Top. But putting in the little Stopple, I left the Veſſel cloſed for 2 or 3 Hours, and at my Return to viſit it, I perceived, that it had acquired a faint Colour tending to a Green: Wherefore, taking out the Stopple again, I opened its Commerce with the *outward Air*, leaving the *Glaſs* unſtopt for 20 or 24 Hours, but found that in all that time it had not regained its wonted dark Colour, but was only arrived at a Green, deep enough, but not true nor very tranſparent.

This Obſervation being made in the ſame Veſſel that had been formerly employed, ſuggeſted to us an Enquiry, whether the advanced Time of the Year, which was the middle of *October*, might not have an Intereſt in the *ſlow* and *imperfect* Succeſs of this Trial.

3. Some ſtrong *Spirit* of *Salt* having been kept upon *Filings* of *Copper* till the Solution was come to be of a dark *brown* Colour, about three Spoonfuls of it, by gueſs, was put into a *Receiver* that might hold 8 or 10 Times as much: Being kept *in Vacuo*, if the Time be rightly remember'd, about half a Year, it retain'd its Colour; but the Veſſel being opened, and the external Air permitted a free Acceſs to it, the Solution in about an Hour was turned into a fine tranſparent Green, tho' no Precipitation of any muddy Subſtance appear'd by any Sediment to be made.

4. In one of that Sort of *Conical Glaſſes* that has been already deſcribed, we had put upon ſome *Filings* of *Copper* a convenient Quantity of our *Spirit* of *Salt*; and tho' we obſerved, that for a great while it would not part with its *deep* and ſomewhat *muddy Tincture*; yet we left it in the *Window* for many *Weeks* longer, and at length, towards the latter End of *December*, we found it to have loſt its *Tincture* ſo much, that the Liquor appeared like common *Water*. Upon which Obſervation, tho' the Time of the Year was unpromiſing, I thought fit to try whether the Air in that Seaſon would not have ſome, tho' perhaps but a ſlow Operation on the *ſaline Spirit*; and accordingly taking out the Glaſs Stopple to give free Acceſs to the *outward Air*, we obſerv'd, that in ſome Hours its Operation on the Liquor was ſcarce ſenſible; but within about 24 Hours, the *Menſtruum* had acquired not juſt its former Colour, but a ſomewhat faint and moderately tranſparent Green: So that this tincted

Menſtruum, as it had been very ſlow in loſing its Colour, ſo it did but ſlowly and imperfectly re-acquire it.

5. We took ſome *Filings* of *Copper*, and putting them together with a *Mercurial Gage*, in a *Conical Glaſs* fitted with an exactly ground Stopple of the ſame Matter (which was *Cryſtalline*) we poured on the *Filings* as much rectified *Spirit of fermented Urine* made *per ſe*, as ſufficed to ſwim an Inch or better above them; then carefully ſtopping the Glaſs, coming to look on it many Hours after, we perceived that the *Mercury* in the ſeal'd Leg was conſiderably depreſt; and gently drawing out the Stopple, to let in the *outward Air*, we perceived that Acceſs to have a manifeſt Effect upon the *Mercury*.

6. We took a *Cryſtal Glaſs* of an almoſt *Conical Shape*, and capable of containing between 5 or 6 Ounces of *Water*, and furniſhed with a Stopple of the ſame Matter, that by grinding was exactly fitted to it. Into this we put a conſiderable Quantity of clean *Filings* of good *Copper*, on which we poured as much ſtrong *Spirit of Fermented*, or rather *putrify'd Urine*, as ſerved to ſwim about an Inch above the *Copper*, and having let down a *Mercurial Gage*, ſo that it leaned upon the Bottom and Side of the *Glaſs*, we clos'd it very well with a Stopple, and ſet it in a quiet and well enlightned Place, having taken good notice at what Mark the *Quickſilver* reſted in the *open Leg* of the *Gage*. This done, we let in the *Menſtruum* alone to work upon the *Filings*; which it did, as we foreſaw, ſomewhat ſlowly and very calmly, without producing any *Noiſe* or ſenſible *Bubbles*, acquiring by Degrees a very pleaſant *blue* Colour, and the Glaſs being kept quiet in the ſame Place for 2 or 3 *Days* longer, the Liquor, as I conjectured would happen, began to loſe of the *Intenſeneſs* of its *Colour*, which by Degrees grew fainter and fainter, till at the End of 3 or 4 *Days*; the Liquor was grown very *pale*, and left me little doubt but that, if I would have ſtayed ſome *Days* longer, it would have loſt the remaining Eye of *Blue*, and have look'd almoſt like common *Water*. But being unwilling to tarry ſo long, I took out the Stopple, that the *Air* without the Glaſs might have Acceſs to that within; and leaving the Vial in the ſame Place and Poſture, my Expectation was ſomewhat anſwered by finding, that within 4 or 5 *Minutes*, if not leſs, the upper Part of the Liquor that was *contiguous* to the *Air*, had acquired a fine *blue Colour*, which deſcending deeper and deeper, before the End of the 10th *Minute* had diffuſed itſelf, but ſomewhat weakned, through the Liquor, whoſe Colour was ſuffered to deepen for a while longer; ſo that in leſs than a *quarter* of an *Hour* from the firſt unſtopping of the Vial the Liquor was grown to be throughout of a rich *ceruleous* Colour, which grew almoſt too opacous within a few *Minutes* longer: When carefully cloſing the Vial again with the ſame Stopple as before, we ſet it aſide in the ſame Place, where the *included Air* being denied all Commerce with the *external*, the Liquor began again within 2 or 3 *Days* to loſe of its Colour; and, to be ſhort, afforded me the Opportunity of making a 2d Experiment much like the former. And the like Succeſs I had, for the main, in a Trial or two made in another Glaſs with another Portion of the ſame *Spirit* of *Urine*, put upon the *Filings* of *Copper*; ſo that the Experiment was, in all, made diverſe Times, as well when I was not, as when I was alone: And parti-

cularly, once to be ſure that the diurnal Air, as ſuch, had not any great Intereſt in the *Phænomenon*, I made the Trial ſucceſſively about Nine a-Clock at Night.

In moſt of theſe Experiments I forbore to ſhake the Glaſs, leſt it ſhould be ſuſpected, that the Agitation of the Liquor might have raiſed ſome little fine Powder that might have been ſuppoſed to have been *precipitated* out of the Tincture, and, being thus mingled with the Liquor again, reſtore it to its former Colour; but in Truth I did not perceive any ſuch Powder to be *precipitated*. And though to obviate the Objection, I forbore to ſhake the Vial, yet I juſtly ſuppoſed, that if, by the Agitation of the Liquor, more Parts of it ſhould be quickly expoſed to the Action of the Air, the Coloration would be haſtned, which upon Trial appear'd to be true.

7. We took ſuch a conical Glaſs, as has been lately deſcribed, and covering the Bottom of it with a convenient Quantity of *Filings* of good *Copper*, we poured on them as much ſtrong *Spirit* of *Sal-Armoniack* as ſerved to ſwim about a Finger's breadth above them; and, having let down ſuch a *Mercurial Gage* as is formerly mentioned, ſo that it leaned upon the Bottom and Side of the Glaſs, we cloſed it very well with a Stopple, and ſet it in a quiet and well enlighten'd Place, having taken good notice at what Mark the *Quickſilver* reſted in the open Leg of the *Gage*: This done, we let alone the *Menſtruum* to work upon the *Filings*, which it did, as we foreſaw, ſomewhat ſlowly and very calmly, without producing any *Noiſe* or ſenſible *Bubbles*, acquiring by Degrees a very pleaſant *blue* Colour, and afforded us alſo the *Phænomenon* we chiefly looked after; which was, that repairing from time to time to the Window to ſee what paſt, we perceived, that for 2 or 3 *Days* together the *Mercury* in the *ſeal'd* Leg of the *Gage* did, tho' very ſlowly, *deſcend* till it appeared to be near a *Quarter* of an *Inch* lower than at firſt; and probably the Depreſſion might have been greater, if the Experiment had not been diſturb'd; whoſe Event yet ſeem'd ſufficiently to argue, that the *Spring* of the *Air* contain'd in the Cavity of the Glaſs, and communicating with that in the *open Leg* of the *Gage* or *Syphon*, was *weakned* in Compariſon of that in the *cloſed Leg*, which by the *Hermetick Seal* on one Side, and the *Quickſilver* on the other, was kept from ſuch Communication. And I was farther careful to obſerve, whether the *Depreſſion* did not continue at differing times of the *Day*, and found it to do ſo, as well at *Night* as at *Noon*, though at this laſt named time the *Sun ſhined* hot upon the Place and *Veſſels* too.

This Experiment was made, in all, 4 or 5 times, though not always with equal, yet ſtill with ſome Succeſs, the *Mercury* in the *ſeal'd Leg* of the *Gage* being ſometimes more, and ſometimes leſs, but always manifeſtly *depreſt*; which *Phænomenon* was confirmed by the Obſervation we more than once made of the ſudden Return of the *Quickſilver* to its former Station, upon the unſtopping of the Glaſs, to give free Admiſſion to the *outward Air*.

8. A *Mercurial Gage* having been put into a Conical Glaſs, whoſe Bottom was covered with beaten *Coral*, ſome *Spirit* of *Vinegar* was poured in, and then the Glaſs Stopple, which was very well ground, cloſing the Neck exactly, we obſerved, tha upon thet working of the *Menſtruum* on the *Coral*,

Stage

Store of *Bubbles* were for a good while produced, which ſucceſſively broke in the Cavity of the Veſſel; and their Acceſſion ſo conſtipated the *Air*, that they *compreſt* the *Air* impriſoned in the cloſed Leg of the *Gage* three Marks or Diviſions, which I gueſſed to amount to about the *third part* of the Extent it had before: But ſome *Hours* after the *Corroſion* had ceaſed, the *Compreſſion* made by this new generated *Air* grew manifeſtly fainter, and the impriſoned *Gage Air* drove down the *Mercury* again till 'twas *depreſt* within one Diviſion of its firſt Station; and thereabouts, or a little lower, continued 5 or 6 *Days*; ſo that in this Operation there ſeemed to have been a double *Compreſſive* Power exerciſed; the one tranſient, by the briſk Agitation of *Vapours* or *Exhalations*; and the other durable, from the *Aereal* and *Springy* Particles either produced or extricated by the Action of the *Spirit* of *Vinegar* upon the *Coral*.

But a pretty Quantity of *Spirit* of *Vinegar* being put upon *Minium*, it continued divers *Days* without any ſenſible *Depreſſion* of the *Mercury* in either Leg, nor did any Change appear in the *Gage*, upon the Removal of the Stopple, though 'twas evident by the great Sweetneſs acquired, that it had made a *Solution* of a great Portion of the *Minium*.

9. We took ſome *Filings* of *Copper*, and in a Vial capable of holding ſome 2 or 3 *Ounces* of Water, we poured on them ſtrong *Spirit* of *Sal-Armoniack* made without *Quick-lime*, till the Liquor reached near an Inch above them. This was done about the 20th of *Auguſt* on the *Friday* before Noon, and the *following Monday*, preſently after Dinner, it had acquired a deep *Blue* Tincture, and loſt again ſo much of it, that it was pale almoſt like common Water: Then to ſatisfy a *Virtuoſo*, I unſtopt the Vial, deſiring him to place his Eye level with the Surface of the Liquor, which in a *Minute* of an *Hour* or leſs appeared to his Surpriſe and Wonder to have acquired a deep *Blue Tincture*, that reached *downwards* to the Thickneſs of the Back of a Knife, the whole Liquor becoming of the like Colour in 4 or 5 *Minutes* more, and the Glaſs being preſently ſtopt again, and left where 'twas before, appeared not at the End of 9 Days to have loſt its *Tincture*; tho' now and then within that Time it ſeemed manifeſtly *paler* than when the Vial was ſtopt.

10. We took a round Vial, holding about 8 *Ounces* of Water, and having put into it *Filings* of *Copper* and a *Mercurial Gage*, we poured on the Metal ſtrong *Spirit* of *Sal-Armoniack*, till it reached to a good Height in the Vial, which then being *Hermetically ſealed* up, was ſet by in a South *Window*, where it quickly acquired a deep *Blue Tincture*: There it ſtood about 12 Days, before that *Tincture*, which decayed but ſlowly, did little by little grow ſo diluted that the Liquor was pale and almoſt like *Water*; during this Stay of the Glaſs in the *Window*, the *Mercury* in the *open* Leg appeared to be *impelled* up; and when after 9 a-Clock at Night (which Time I choſe to try whether the *nocturnal Air* would have any thing to do with the *Phænomenon*) the *hermetick Seal* was broken off; immediately upon which there was produced a *Noiſe*, and the *Mercury* in the ſhorter and cloſed Leg was briſkly *impelled* up, by our Gueſs, near $\frac{1}{8}$ of an *Inch*; and tho' the Orifice at which the Air had Acceſs was ſcarce *wide* enough to admit a middle-ſiz'd Pea, yet

within a *Minute* and *half* the Surface of the Liquor being held between the Eye and the Candle, appeared to have acquired a very lovely and fair *Colour*, which reached downwards a quarter of an Inch; ſo that the Vial ſeemed to contain two very differing Liquors ſwimming one on another; and the Coloration piercing deeper and deeper, within 5 Minutes in all, the whole Liquor had attained a rich *Blue Colour*.

Pneumatical *Experiments by* M. Papin: *Directed by* M. Hugens, n. 119. p. 443.

LXXIX. 1. To mingle divers Liquors together by Means of the Air Pump, there were employed two ſmall Glaſſes, whereof the one could enter into the other, and the leaſt of the *two* was faſtened to the Hook of an *Iron Wire*, and the greater put under it, and the ſaid *Wire* was ſo ordered, that theſe *two* Glaſſes were a little diſtant one from another. The *Recipient* was of a Cylindrical Figure, of which one End is all open, to be faſtned to the Cement of the *Pump*; the other is all cloſed, except a ſmall Hole, having a little Edge or Brim; thro' which Hole you paſs the hook'd *Iron Wire*, and tye an *Eel-Skin* cloſe about the ſame; and three or four Inches higher, the ſame *Skin* is alſo to be tyed about the *Iron-Wire*, to keep the *external Air* from entering into the *Recipient*, and yet without taking away the Liberty to ſtir therein what you will by means of the *Iron-Wire*, that hath a Communication *inwards* and *outwards*. For this Purpoſe you muſt chuſe that Part of the *Eel-Skin* that is next to the Head, the other Part being pierced with many *Holes* with *Valves* that do not always ſhut well.

To be the more ſure that no Air enters by the Ligatures of the *Eel-Skin*, you may apply a Tube on the *Recipient* with Cement, and pour Water into this Tube until the *Eel-Skin* be quite cover'd therewith. Care alſo muſt be had, that the Hole be exactly filled up by the *Iron-Wire*; for, if it were too big, the *Eel-Skin* would be thruſt into it with great Violence, and ſo hinder the Liberty of raiſing and ſinking it.

When the *Recipient* was evacuated of Air, the leſſer Glaſs was by the *Iron-Wire* let down into the greater, until the Liquors they contain did mingle themſelves. Thus ſome *Aqua-fortis* was poured into the upper Glaſs, and *Spirit* of *Wine* into the lower, and the *Recipient* was ſo well exhauſted of Air, that the *Spirit* of *Wine* boiled up with great Bubbles (as uſually it doth) and the *Aqua-fortis* caſt ſome ſmall Bubbles. After that both theſe Liquors were well *purged* of *Air*, the upper Glaſs was ſunk into the lower, ſo as that the *Spirit* of *Wine* was mingled with the *Aqua-fortis*, at which Inſtant there was yet ſeen a very conſiderable *Ebullition*.

Now to know whether the *Aqua-fortis* gave to the *Spirit* of *Wine* ſome new Vigour or Force to make it bubble, we mixed without the *Recipient* ſome *Aqua-fortis* with *Spirit* of *Wine*; the Quantity of the former being ſomewhat more than that of the latter. This Mixture being put *in Vacuo*, inſtead of boiling up more ſtrongly than the *Spirit* of *Wine*, (as 'twas thought it would have done) it only caſt up ſome few Bubbles: Which ſhewed that the *Ebullition*, which was ſeen when they were mixed within the *Vacuum*, is of the ſame Nature with all thoſe that are made of *Acids* and *Alcalies*. For, in the very inſtant that they are mixed they make great *Ebullitions*, but ſoon after they mortify one another, and loſe the Properties they had before.

'Tis alſo probable, that the *Aqua-fortis* and the *Spirit* of *Wine* would boil always when they are mingled, but that the Preſſure of the Air keeps this *Ebullition* from being ſenſible, and appears only when that Preſſure is taken off.

When you employ *rectified Spirit* of *Wine* inſtead of *Aqua-vitæ*, there is required a greater Quantity of *Aqua-fortis* to mortify it.

It was alſo experimented, that the *Solution* of *common Salt* boils alſo with *Spirit* of *Wine*, being mixed *in Vacuo*; and the *Solution* of *Salt Peter* yet more. The ſame Experiment was alſo made with common Water, and its *Ebullition* with *Aqua-vitæ*, purged of Air, was alſo found to be very great, when mixed *in Vacuo*.

Farther, it is ſomewhat remarkable, that *common Water* doth not mortify *Spirit* of *Water*, as *Aqua-fortis* doth, though they make *Ebullitions* with it almoſt of the ſame Degree. The Experiment of it is eaſy: For, making without the *Recipient*, a Mixture of *common Water* and *Aqua-vitæ*, this being put within the *Vacuum*, bubbles up very well, though the *common Water* be there in greater Quantity than the *Aqua-vitæ*; whereas a Mixture of *Aqua-fortis* and *Aqua-vitæ* did not there bubble up at all.

After this, the Experimenter being deſirous to ſee whether theſe *Ebullitions* did make *new* Air, he put in the *Recipient* a Gage (that is a Glaſs Tube fill'd either with Water freed of Air, or with *Mercury* ſerving to meaſure the Quantity of the Air in the *Recipient*) which was 4 Inches long, and obſerved, that, at the Inſtant when the Liquors were mingled together, the *Water* in the *Gage* roſe very nimbly to the Top of the *Gage*; and then drawing out this *new Air* that was made, he made the *Gage-Water* ſubſide again by Degrees, in like manner as when the *common Air* is drawn out: And by this means it was ſeen, that all theſe kinds of *Ebullition* made an Air which expands itſelf like *common Air*. Yet it is very remarkable, that the Air which is made by theſe *Ebullitions* is not of the ſame Nature: For it hath been found experimentally, that the Air formed by the *Mixture* of *Aqua-fortis* and *Copper* remains always Air, and always keeps up the *Water* in the *Glaſs* at that Height to which it raiſed it; but, on the contrary, that *Air*, which hath been produced by the Mixture of *Oyl* of *Tartar* and *Oyl* of *Vitriol*, is almoſt all deſtroyed of itſelf in the Space of 24 Hours; inſomuch that in the *Recipient*, 24 Hours after the *Ebullition* had been there made, there was not found much more *Air* than there was before the ſame was made.

2. Mr. *Boyle* (as 'tis recorded in the *Journal Book* of the *Royal Society*, *April* 30. 1668.) gave an Account to the ſaid *Society* of the Experiments he had then made about *generating new Air*, or *extricating* that *Air* which was lurking before in ſeveral Bodies: At which Time he mentioned alſo ſome ways of *examining*, whether the Subſtance thus produced be *true Air* or not.

And long before that Time, *viz. An.* 1664. *March* the 15th (witneſs the ſame *Journal*) Mr. *Boyle* mentioned to the *R. Society*, that *Corals* or *Oyſter-Shells* pounded, and put into *diſtill'd Vinegar*, might prove fit Subſtances to produce *Air*, wholeſom for *Inſpiration*. At which Time he alſo *propoſed*, that ſome fit Animal might be put into a *Receiver* of his exhauſting Engine, and the *Air* pump'd out till the Creature grew ſickiſh, and that then ſome *new Air* might be produced in the *Receiver* by a Contrivance of making *diſtill'd Vinegar* work upon the Subſtances before-mentioned, to ſee whether by this means the Animal would recover.

About which time Sir *Chr. Wren* alſo ſuggeſted, to put a *fermenting* Liquor in a Glaſs Ball, and to fit a *Stop-Cock* to it, and tye a Bladder about the Top of the *Stop-Cock*; by which means the *Air*, to be *generated* by the *fermenting* Liquor, would paſs into the Bladder, and upon the turning of the *Stop-Cock* be kept there in the form of *Air*. Mr. *Hook* alſo mentioned ſeveral Liquors, which by their working upon one another would produce an *Air*; as *Oyl* of *Tartar* and *Vitriol*; *Spirit* of *Wine* and *Turpentine*. And the ſame made before the *R. Society* the following Experiment: He took a common Glaſs Vial with two Pipes, and ſome pounded *Oyſter-Shells* and *Aqua-fortis*; and as ſoon as the latter was by one of thoſe Pipes poured upon the former, and the Hole ſtopt with good Cement, the *Ebullition*, cauſed by the *Shells* being corroded by the *Aqua-fortis*, did in a very little Time blow up the Bladder, tyed on the other Pipe, ſo as to ſwell it very plump with *Air*; which Expanſion remained till the *Society* roſe. They afterwards order'd the ſaid Veſſel to be carefully lock'd up till their next Meeting, which being the Week after, the Bladder was then found ſomewhat ſhrunk. The like Experiment was made with Bottled Ale, ſuppoſed to yield more wholeſom Air for Reſpiration.

3. One Day we mingled equal Parts of *Aqua-fortis* and *Aqua-vitæ*; and having put two equal Quantities of this Mixture in two ſmall Glaſſes with two equal Bits of *Iron*, one into each; one of the Glaſſes was included *in Vacuo*. Then there was ſeen a very great *Ebullition*, and the Liquor became *black*, whilſt that which was left without the *Recipient* wrought almoſt nothing, but remained always tranſparent, and rather white than black. After theſe two Glaſſes had ſtood thus 12 Hours, that which was *in Vacuo* was taken out, and we found that the *Iron* was almoſt all diſſolved, whereas the other was very little diminiſhed. This Experiment ſucceeds quite contrary when 'tis made with *Aqua-fortis* alone and *Copper*; for then the *Diſſolution* is leſs within the *Vacuum*, than without it.

We made ſome other Mixtures of diverſe Liquors, which make no *Ebullition* at all *in Vacuo*, no more than they do in open Air. *Oyl* of *Olives* makes none neither with *Vinegar*, nor with *Spirit* of *Wine*, at the inſtant that they mingled; neither doth the ſaid *Oyl* mortify the *Spirit* of *Wine*. Only this we obſerved one Day, that having mingled together, without the *Recipient*, ſome of that *Oyl* and *Vinegar* and *Spirit* of *Wine*, and put this Mixture *in Vacuo*, it did not boil up ſo ſoon as when there was no *Oyl*; but then the Bubbles which it made afterwards were bigger, and they began to appear again from Time to Time, ſo that ſome of them were ſeen a Quarter of an Hour after the *Recipient* had been evacuated. Poſſibly this may come to paſs, becauſe that the *Oyl*, ſwimming on the Top, retains the more volatile Parts of the *Spirit* of *Wine*; which elſe would fly away as ſoon as the Air is begun to be pump'd out, and at the ſame Time it hinders the Surface of the Liquor below from eaſily riſing up into Bubbles, becauſe, to make them do ſo, the Parts of the *Oyl*, that ſticks cloſe to one another, muſt be ſeparated. When therefore the volatile Parts are gathered together in a ſufficient Quantity, able to ſurmount the Reſiſtance which the *Oyl* makes to it, they iſſue out with much more Violence, than if nothing had retained them.

All theſe *Ebullitions*, hitherto ſpoken of, are greater *in Vacuo* than in the *open Air*: But with *Lime* it is not ſo. For, taking two equal Glaſſes with two equal Quantities of *Water*, and putting the one of them *in Vacuo*, the other in the free Air, there was let fall into both at the ſame Time two equal Parcels of *Lime*, one into each, and it appeared, that that which was *in Vacuo* did indeed throw up ſome big *Bubbles*, but yet fewer of them than that which was in the Air; and having taken it an Hour after out of the *Recipient*, and ſtirred the *Lime*, it was found to have only the Conſiſtence of *Dirt*, whereas the other had the Conſiſtence of *ſlaked Lime*. The Reaſon of which may perhaps be, that the *volatile Salts* of the *Lime* do exhale whilſt the *Recipient* is emptying.

There was alſo ſome *Plaiſter* of *Paris* ſlaked *in Vacuo*, and the *Ebullition* of it did there appear much more than it doth in the open Air. When it is not touched, the Bubbles that iſſue out leave great Holes in it, and then it ſettles very uneven; but taking care to ſtir it until the *Bubbles* be come forth, and preſſing it when it begins to ſettle, it becomes very ſmooth, and hath not ſo many little *Holes* as the *common Plaiſter*.

I took one Day a ſmall *Recipient*, and inſtead of the *Iron Wire* I paſſed into the little *Hole* a Sprig of a known Plant, which was *Balm*, ſo as that the *Top* of the Plant was within the *Recipient*, and the *Roots* without. Then I cloſed the reſt of the *Hole* with Cement, and when I had taken away my little *emptied Receiver*, with the Plant half ſhut up therein, I put the whole into a great Glaſs fill'd with *Water*, the Root being downwards; and I ſaw that there were formed little *Water Drops* upon the Leaves that were *in Vacuo*. I left it ten Days in this Condition, and during that Time there were entred about *two* Spoonfuls of *Water* into the *Receiver*, and in all Appearance this *Water* had preſſed through the Plant. Yet there appeared no more any Drops upon the Leaves; but that might very well come from the groſſer *excrementitious* Matter that is in the *Water*, which had ſtopp'd the Conduits.

After this, to know whether any Air had been form'd there, I replaced the *Receiver* upon the Engine, and having whelmed a bigger upon it, I ſaw there was but very little Air formed in the ſmall one, becauſe the great *Recipient* was almoſt all empty before the Air included in the little one could lift it up. Yet at laſt it did raiſe it, and I inclined the Engine, to the End that the little *Receiver* might not be applied to its *Cover*, when I ſhould let the Air reenter; and after this Manner both the *Recipients* were filled in the ſame Time. Then I looked upon the Leaves of the Plant; they were not withered, though they were not grown; only the Leaves had in the Middle a little changed their Colour, and had a Smell ſomewhat ſowriſh; but the next Morning the Plant was quite ſpoiled. We may believe that the Preſſure of the Air had made the *Water* enter into this Plant with ſo great a Violence, that thereby it had, as it were, mortified the Parts, eſpecially in the Middle where the Leaves were moſt tender; but this Water ſtill kept the Leaves, extended, and ſo they withered not; but, when the Air came to act upon them, the Parts of the Plant which had ſo much ſuffered were ſoon corrupted by it. For 'tis very probable, as well by this Experiment, as by others hereafter to be mentioned, that the Air is a Diſſolvent which corrupteth Bodies.

This being done, I made the Experiment the other Way, that is, with the Leaves in the Air, and the *Roots* in a *Bottle* of *Water* that was *in Vacuo*; and immediately I ſaw Air-Bubbles iſſuing out at the End of the Tail *in Vacuo*. After this I put Water upon the Leaves, to ſee whether this Air came from thence, and I ſaw indeed ſoon after that theſe Bubbles began to ceaſe; and having taken away the Water wherein the Leaves were, I ſaw that the Bubbles began to iſſue out at the Tail as before: And I ſaw them ſtill come out 24 *Hours* after, but in *little Quantity*; and at length it quite ceaſed. During theſe 24 *Hours* the *Roots* did lengthen about four Lines, that is, one Third of an *Inch*, which is little leſs than they ordinarily do in the *Air*.

I kept the Plant in this Condition *for four Days* upon the *Engine*, and took care from Time to Time to draw out the Air that entered into it by the Leaves; and then it began to *wither*, and the *Roots* ſhot no more.

Another Time I put *two Twigs* of *Balm*, each into a Vial full of *Water*, and at the End of 5 Days, when I ſaw manifeſtly that they both ſhot *Roots*, I included in the *Vacuum* that of the *Two* which had the *longeſt Roots*, without taking it out of its Vial. At the end of *three Days*, obſerving that it was *wither'd in Vacuo*, I took it out, and changed the Vials of the *Twigs*, to ſee, whether that which remained in the Air, and did thrive very well in *common Water*, would alſo thrive in *Water freed of Air*; and whether that which was *wither'd in Vacuo* would revive in the *common Water* and in Air. *Four Days* after I found the *Twig* that had been *in Vacuo* quite ſpoiled, and the other ſtill verdant, but not thriving; and I obſerved, that it did not begin to ſhoot in the *Water freed* of *Air* till *ten Days* after it had been put in.

This Experiment drew another after it, to know whether the Water purged of Air were leſs fit than common Water to make Plants *vegetate*. For this End I took *two* Vials full, the one of Water purged, the other of common Water, and having put a *Twig* of *Balm* in each, I left them both in the Air. I found, that the *Twig* in the common Water ſhot at the end of Six Days, and in Water purged ſhot this Time neither but *ten Days* after it had been put in.

I repeated this Experiment once more, and I was much ſurprized to ſee, that the *Twig* in the Water freed of Air begun this Time to ſhoot the 3d Day, and the other in the common Water ſtill the 6th Day. But this was remarkable herein, that the *Twig* in the Water purged ſhot no more but one *Root*, which grew very long, and on the 9th Day only it began a little to ſhoot another, which lengthened but one Line in *two* Days, whereas the *Twig* in the common Water had then 9 or 10 *Roots*, which were all very long, having always lengthened *five Lines* or more in a Day.

Although this Experiment appear'd at firſt contrary to the precedent, yet it ſtill confirmed the firſt Thought, to wit, that the Air which is mixed in common Water ſerves for *Vegetation*, conſidering the little *Root* which the *Twig* ſhot in the Water cleanſed of Air.

After this, I made ſome Experiments upon harder Plants. One Day I put a green Piece of *Sallow-Wood*, part in the Air and part *in Vacuo*, after the Manner above deſcrib'd. I put into Water that Part which was in the Air, and the Water preſently began to mount and to paſs through the Middle of the Wood, and inceſſantly formed *Bubbles* in the *Receiver*. Theſe *Bubbles* continued thus for the Space of 24 *Hours*; and certainly it was the *Water*, which paſſing through the *Wood* was in part changed into *Air*. For I made the ſame Experiment with a Piece of *Buffe*, and the Water mounted alſo and paſſed through it, but it formed no *Bubbles*. Mean time, if there be *Valves* in *Wood*, they muſt needs be unable to reſiſt the *Preſſure* of the *Air*; for I have noted in *Sallow*, as well as in *Elm*, that the Water paſſes thro' them with the ſame Facility what End ſoever you put *in Vacuo*.

One Day alſo I put the *upper End* of a little *Elm Branch* in the *Vacuum*, and the *lower End* in the *Air*. This *lower End* I trenched in Water, as I had done the Roots of *Balm* before: But it was a whole Hour before there appeared any *Drop* of *Water* upon the *Elm-Leaves in Vacuo*, whereas upon the *Balm-Leaves* the *Drops* appeared preſently. The Cauſe of which may be the Hardneſs of the *Elm-Wood*. But I know not why Water paſſing thro' Wood forms *Bubbles*, and in paſſing thro' Leaves forms nothing but Drops.

I made alſo the Experiment the other Way, that is, the *Leaves* in the Water without the *Recipient*, and the *lower End* of the Branch *in Vacuo*, and I ſaw, that there paſſed nothing for two Hours time; inſomuch that I cut a little of the upper End of the Branch which was very tender, and then indeed I ſaw a little Moiſture appear at the End that was *in Vacuo*, but that enough only to form one Drop, and there appeared no Bubbles of Air. Then I cut the Branch yet a little lower, and then there was formed one Drop of Water at the End that was *in Vacuo*, but it fell not. And having cut the Branch yet a little more, the Drop of Water fell down *in Vacuo*. This ſhews, that they were not the *Valves* of the *Plant* that hindred the Water from paſſing whilſt the Branch was entire; but rather that it was the great Tenderneſs of the Leaves, ſuffering themſelves to be compreſſed by the Preſſure of the Air, and that ſo the Water could not inſinuate itſelf between their Parts.

Apr. 3. 1673. * I included an *Apple*, which had a little Speck of *Rottenneſs*, and ſome Water in the ſame *Recipient*, thereby to promote the *Corruption*, in caſe any ſhould come to paſs: But I have not found that any *Change* happen'd to it ſince that Time.

n. 121, p. 422. * *Theſe* Experiments *were* printed *at* Paris, in the Year 1674.

Jun. 7. I included in a *Receiver* two *Noſegays* of *Roſes*, one ſuſpended at the Top, the other having its Tail in a little Veſſel full of Water. I alſo put in the ſame *Receiver* a Gage 4 Inches long, to know whether any Air would be there produced. Two Days after I found my *Roſes* a little wither'd, and the *Water* already riſen to 8 or 10 *Lines* near the Top of my Gage; and after that the Changes of theſe *Flowers* became leſs ſtill, ſo that at this preſent time they are not much more wither'd, and the Water of the Gage is by 3 or 4 Lines nearer the Top. The *Roſes* which lie dipt in the Water are as much withered as the others, and as ſoon. Other *Roſes* which I had included at the ſame Time, but with Air, grew mouldy in leſs than eight Days.

At another time I included one ſingle *Roſe-Button* in a very little Glaſs, to learn whether it would keep its Scent. At the End of 15 Days it looked a little leſs freſh, but was not at all wither'd; and having taken it out, I found it had ſtill its good *Smell*; but after that it loſt both *Colour* and *Smell*, in leſs than two Hours. I muſt alſo add, that its Leaves did not appear moiſt in the *Vacuum*, but they look'd all moiſt as ſoon as they were in the *Air*: Which ſhews, that the Parts of the Leaves had acted as Springs, like as *Spunges* do, and that the Weight of the *Air* coming to preſs upon them, did expreſs the Humidity, which had inſinuated itſelf between the Parts thus expanded.

I did alſo include ſome *Gilly-Flowers*, which changed but very little; only they looked as if they had been dipped in Water.

Having included ſome *Strawberries*, at the End of two Days they look'd leſs freſh; but after that, ſeeing they changed no more, I took them out of the *Vacuum* after they had been there 15 Days. They had ſtill the Smell and Taſte of *Strawberries*; but they had alſo contracted a very ungrateful Taſte of the Cement which I then employed to cloſe them up with.

Vid. Sup. §. LXXIV. At another time I put ſome *Strawberries* without Cement, making uſe of a Skin, after the Manner deſcribed formerly, and I then obſerved nothing new, except that their Taſte kept good, but was a little ſowriſh, and that they yielded a little Water.

Jun. 24. I included ſome *Cherries*, to the Number of 25 or 30, in a *Receiver* which was almoſt fill'd with them. They all burſt but two. *Two Days* after they had a little changed their Colour, and thoſe two, that before remained whole, were not burſt like the reſt. After that, I obſerved no more change in them.

Jul. 20. I included in the *Vacuum* one *Cherry*, with eleven great *Currants*. The *Cherry* burſt preſently, and after that I found it not changed, only it appeared turned, as the *Currants* alſo did: This is a Beginning of Putrefaction, which may be imputed to the Air that remains in the *Receivers*.

Jul. 27, I included in the *Vacuum* four *Raſberries* and three *Currants*. The latter appeared alſo to be turned, and the *Raſberries* looked leſs freſh than they were. But 'tis now more than five *Months* that I perceive no Change in them.

Hitherto I had employed none but *ſmall Receivers*, which did juſt hold that little Fruit I put in them, and the *red Currants* ſeem'd to keep well enough; ſo that one Day I filled a great Glaſs, of the Figure of *cupping Glaſſes*, with them, hoping to keep that as well as the *ſmall Receivers*. But I was ſurpriz'd five Days after, to ſee that *Bubbles* were formed in the *Turpentine* which I had put about the ſaid *great Glaſs* in the Place were 'twas faſten'd to its *Cover*, and that theſe *Bubbles* were burſt outwards; and afterwards having ſeen that the *Cover* held faſt to the *Bolt-head* no longer, I made no doubt of the *Currants* having produced Air enough to lift up the ſaid great Glaſs, and to form in the *Turpentine* the *Bubbles* I had ſeen. I was confirmed in this Thought, when I found by the *Smell* that they had fermented. They were yet good; except ſome that had loſt almoſt all their Taſte, and all their Acidity.

The ſame thing happen'd to me with a very *ſmall Receiver*, that could hold no more but one *Cherry*, of that Kind we call *Bigarreaux*, and one *red Currant*: Theſe Fruits yielded alſo Air enough to lift up their *Receiver* 7 Days after they had been included therein: And having reiterated this *Experiment*, I found the ſame Succeſs; only this ſecond Time the *Receiver* was not lifted up till the 11th Day. This Effect is rather to be aſcribed to the *Cherry* than the *Currant*, becauſe I have kept *Currants* to the Number of 11, in a ſmall Glaſs, and they did not raiſe it up. Whence it follows, that the *Bigarreaux* yield much more *Air* than acid Fruit.

Another time I included ſome of the ſame Kind of *Cherries*, a whole great Glaſs full, and found, that from the ſecond Day they had yielded *Air* enough to lift up the *Cover*. I took away Part of the *Cherries*, and included the reſt again.

This ſecond time they did not raiſe the Glaſs till the 8th Day. The *Cherries* looked fair, but they had loſt much of their Taſte, and afterwards they were ſpoiled in leſs than an Hour.

I did alſo one Day include three *Pears*, of that Sort we call *Rouſſeletes*, in a like figur'd Glaſs, which could hold no more. They lifted up the Glaſs at the end of five Days, and they were not changed, only one of them was a little ſofter.

Another time I put a *Peach* in ſuch a Glaſs emptied of *Air* with a Gage to it; and I found, that the firſt 6 Hours the *Quickſilver* in the Gage was riſen about an *Inch*. Yet it was not till the 13th Day that the Glaſs was lifted up; and the *Peach* appeared to have kept very well till then; but after that, it rotted in a very little Time.

I did once put ſome *Bread* with a *Gage*, but I found not that for the Space of a whole Month it had yielded any Air, ſo that I took it out, and found it yet good; only it had a little taſte of *Muſtineſs*, which yet appeared not at all to the Eye, and whereof the Cauſe may be aſcribed to that little *Air* that might reſt in the *Receiver*.

One Day I included a Piece of roaſted Mutton with a Gage, and found, that in 4 Days it had yielded no Air, but after my Abſence of 6 Weeks, I ſaw the *Mercury* was riſen to the Middle of the Gage, and having taken out the Meat, I found it of a very ill Smell.

Two Days after, I included a Piece of *raw Beef*, and a *Gage* with it, and I ſaw, that in 2 Days the *Quickſilver* was riſen an *Inch* in the *Gage*; and after 6 Weeks Abſence, I found the *Mercury* was got almoſt to the Top of the *Gage*, and that this Meat had contracted a much worſe Smell than that which had been roaſted.

I alſo kept for 15 Days a Piece of *freſh Butter in Vacuo*, and I found, that it ſmelt more ſtrong than when I firſt put it in: But yet it could be ſtill eaten upon Bread, whereas another Piece of *Butter*, which at the ſame Time I had kept in the Air, was altogether unfit to be eaten.

One Day I covered a *Receiver*, whoſe 4th Part was fill'd with Water, and n. 122. p.
the reſt all empty. I put it over the Flame of a *Candle*, and ſaw that the 544.
Water boiled very quickly, yet the Glaſs not much heated; ſo that the *Wa-*

ter boiled near a quarter of an Hour, with a great *Ebullition*, and the Glaſs was no more than tepid. I then took it away from the Flame, and ſaw that the *Water* continued a very great while boiling, and that it began again from Time to Time. I then believed that the Vapors which had been raiſed into the Air were recondenſed by the Cold, and that that made the *hot Water bubble* up, as *Water* uſually doth when 'tis put into the *Engine*, and the *Air* that preſſes it exhauſted. Mean Time, I have ſince made the Experiment with a Gage, and I did not perceive, that all the *Bubbles* that iſſued out of the Water made the *Mercury* riſe to Senſe.

After this, I left my *Receiver* expoſed to the Froſt, and I found that the *Ice* which was made therein was not yet quite free from *Bubbles*, though the Water thereof had boiled in the *Vacuum*, which one would think ſhould have driven out all the Air; yet the *Bubbles* were there far leſs numerous than in *Ice* made of ordinary Water. I perceived not that the *Quickſilver* was much riſen in the *Gage*. Afterwards I melted this *Ice*, and put the Water abroad to freeze again, ſtill without taking it out of the *Vacuum*, and I found that this ſecond Time it was very much freer from *Bubbles*. The Glaſs did not break; but becauſe it was ſomewhat conical, we could not know, whether it remained whole upon the Account of its Figure, or becauſe that the Water which was frozen within was freed of *Air*.

After this, I made *Spirit* of *Wine* boil *in Vacuo* in the ſame Manner I did the Water, and I ſaw that it boil'd much ſooner. It made the *Mercury* riſe about an *Inch* in the Gage. Then I took it from the Fire, and ſaw it continue in its Boiling; and even ſinking the *Receiver* into cold Water, it thereupon boiled much more ſtrongly. One would think this proceeded from an *Antiperiſtaſis*; but we have more ground to ſay it came from hence, that the Vapors of the Spirit were condenſed, and ſo made the *Receiver* more empty; which is ſufficient to make the Spirit of Wine boil, even tho' it were not hot. The *Quickſilver* did in *two Hours* ſubſide again, to near half a Line as low as it had been. Then I put the *Receiver* over the Flame again, and made the *Mercury* riſe more than *two Inches*; but then the *Receiver* cracked.

One Day I took a *Tube* of *Plaiſter* of *Paris*, open at one End, and cloſe at the other. I applied the open End to the Cement as I was wont to do *Receivers*; and I ſaw it was not poſſible thus to exhauſt it, becauſe the *Air* did eaſily paſs thro' the *Plaiſter*. I put therefore a *Tube* of *Iron* on the *Engine*, ſo as having filled it with Water, the Tube of *Plaiſter* was covered therewith, and then having cauſed the *Pump* to be plied, I found, that the *Water* did paſs as eaſily thro' the ſaid *Plaiſter*. I therefore covered it with *Venice-Turpentine* inſtead of *Water*, and then I ſaw that it evacuated very well, and that nothing paſſed thro' it for the Space of *two Hours*. Then I took ſome Oyl very hot, and poured it over the *Turpentine*, which did melt by this Heat, and paſſed thro' the *Plaiſter*. Then I took off this Tube, which was ſo pervaded by the *Turpentine*, and I ſaw, that that had made it *tranſparent*: Which effect is pretty like, and is to be explicated in the ſame Manner as that of the little Stone called *Oculus Mundi*. Thus we may be aſſiſted by the Weight of the *Air* to make diverſe Sorts of *Glues* penetrate *Plaiſter*, *baked Earth*, *Wood*,

Wood, &c. And poſſibly thoſe, who ſhall make a good Number of ſuch Trials, will find their Labour and Pains recompenſed, by giving to thoſe Materials ſuch Properties as they never had before.

I did alſo put ſome *Eggs* in the *Vacuum*, and one Day I ſaw one of them break, which I had put in a ſmall *Receiver*. It burſt upon the very firſt *Suction:* But ſince that Time I could never make any *break*, tho' I exhauſted as much as I could thoſe *Receivers* wherein I had put ſome. You muſt therefore begin to crack them a little before you put them in the *Vacuum*, and then they do eaſily break quite, and what is in the Egg riſeth all into a very thick *Froth:* I alſo put ſome of theſe thus ordered over the Fire, where they boiled very eaſily, not being preſſed by the Air; but they boiled there very long, before it began to appear that they were ſo boiled as to be ready to eat.

All the little Bubbles, that appear in *Muſtard*, do ſwell and break *in vacuo*; and after that the *Muſtard* is ſeen to be without Bubbles.

One Day I included a *black Ribbon* in the *Vacuum*, and then burnt it with a *Burning-Glaſs*. Abundance of Smoke iſſued out of it, which fell by little and little, and ſo permitted us to ſee the *Ribbon* plainly; which appeared not at all changed. But after I had returned the Air into it, and touched it, I found it turned to Aſhes.

Another time I cauſed ſome *Gunpowder* to be burnt after the ſame Manner; and I was much ſurprized to ſee that it burnt Grain by Grain, none of the kindled Grains firing thoſe which touched. Another time, when the Sun had leſs Force, I could not at all kindle the Powder, but I made it only boil and emit Store of Smoke. I had put a Gage in the ſame *Recipient*, by means whereof I obſerved, that that Smoke produced no Air; for the *Quickſilver* did not riſe in the Tube. I noted alſo, that this Smoke falling upon the Paſtboard, on which I had put the Powder, appeared yellow, of the Colour of *Brimſtone*. After that, I took out the Powder that remained, being like a black Maſs, and having put it upon burning Coals, I ſaw it burned as doth *Salt-Petre*; and ſo it appeared, that the Sulphur was almoſt all exhaled. I was willing to reiterate this Experiment, and then I ſaw that the Powder after *boiling*, *fuming*, and being kindled Grain by Grain, (as in the firſt Experiment) at laſt flaſhes out all at once, when one hath the Patience to hold the Fire to it with a Burning-glaſs. And when the Fumes are grown clearer, you may ſee Needles of *Salt-Petre* ſticking to the Sides of the *Receiver*.

Another time, I put the Weight of 12 or 15 Grains of *Powder* in a Glaſs, ſhap'd like a *Cupping-Glaſs*, capable to hold 14 Ounces of Water, and having put Fire to it, I made the Powder boil and ſmoke as uſually. Afterwards, ſeeing that the Corns began to crack very near one after another; I then took away the burning Concave, for fear all ſhould be kindled together: But it was already too late; for the Corns did continue to crack longer than a ſecond of Time, and at laſt all kindled, tho' there was then nothing left to heat them but the Fire which they had kept within themſelves. The *Receiver* was lifted up above a Foot high without breaking.

Another time I put the Weight of 18 *Grains* of *Powder*, together with a *Gage*, into a *Receiver* holding 7 Pound of Water; and I ſaw, that the *Powder* was more difficult to be kindled than in ſmall *Receivers*. Yet at length it was kindled altogether, and made the *Quickſilver* riſe to the height of an *Inch* and a half in the Gage; and I am very well aſſured, that all that Air was not come from without; for that Part of the *Receiver*, to which the Cover is applied, had always been under Water.

From what I have been relating it may be concluded, that there is a fifth Part of *Air* in *Gunpowder*, ſuppoſing, as other *Experiments* do ſhew, that Air is about a Thouſand times lighter than Water. For, in this *Experiment*, the *Mercury* did riſe to the 18th Part of the Height where the Air commonly ſuſtains it; and conſequently the Weight of 18 *Grains* of *Powder* did yield *Air* enough to fill the 18th Part of a *Receiver* that contains 7 Pound of Water. Now this 18th Part contains 49 *Drachms* of *Water*: Wherefore the *Air*, that takes up an equal Space, being 1000 times lighter, weighs $\frac{1}{1000}$ of 49 *Drachms*, which is more than 3½ *Grains*. It follows therefore, that the Weight of 18 Grains of Powder, which I employed in my Experiment, contained more than 3½ of Air, which is about the fifth Part of 18 Grains.

It may alſo be calculated, how many times this *Air* hath been *compreſſed* in the *Powder*: But this Calculation is more uncertain than the former, becauſe we know not, whether this Air took up more or leſs than the fifth Part of the Space which the Powder poſſeſſed. But yet 'tis certain, that tho' it had even taken up three Fourths of the whole room of the Powder, and that the 14 Grains of the other Matter had taken up no more than the one remaining fourth Part, ſtill this Air wonld have been compreſſed about three *hundred* times. To calculate this, I ſuppoſe, that the Space of a *Cubick Foot* can hold only 72 Pounds of *Gunpowder*, which do contain more than 14 Pounds of *Air*, by the foregoing *Calculus*; which Quantity of Air is therefore found incloſed in the three Fourths of a *Cubick Foot*. Now this Space doth uſually contain but about 6 Drachms of *Air*: Wherefore, to make it hold 14 Pounds of Air, which is near 300 times ſix Drachms, it muſt needs be, that the Air be compreſſed near 300 times.

There is Reaſon to believe, that this Compreſſion is much greater, becauſe a *Cubick Foot* can hold much more than 72 Pounds of *Powder*, and becauſe alſo that the fifth Part of the *Weight* muſt not in Appearance poſſeſs alone the three Fourths, and all the reſt take up no more than one Fourth of the Space poſſeſſed by all the Powder.

I ſhould therefore make no Difficulty to believe, that all the Effect of *Gunpowder* comes from the Air which is compreſſed therein, and eſpecially in the *Salt-Petre*; for I have not yet obſerved that *Brimſtone* yields *Air*. Poſſibly alſo we may find in time, that all other *Fulminations*, *Ebullitions*, and *Fermentations*, that make ſuch ſurprizing Motions, are nothing elſe but Air compreſſed expanding itſelf.

n. 122. p. 542. One Day I included in the *Vacuum* an Inſect which reſembles a *Beetle*, but is a little bigger; and when I perceived it to appear dead, I gave it Air again, and it ſoon after recovered. Then I put it in the *Vacuum* again, and having left it there for an Hour, I re-admitted the Air, and found, that then the *Inſect* needed much more Time to recover. I included it there the third Time, and having left it there two Days, I gave it Air again, and ſaw it needed about ten Hours before it began to ſtir again; yet it recovered well enough this Time: But having put it in again the fourth Time, and left it there 8 Days, it would never ſtir again.

Intending to try the like upon a *Butterfly*, I ſaw, when I re-admitted *Air* to it, that the top of its Back, which before was much ſwelled, did fall in more than it ſhould, and the *Inſect* would not recover.

I alſo killed in the *Vacuum* many Animals that breath, as *Birds*, *Mice*, *Rats*, *Rabbets*, *Cats*; and ſome of them I recovered by quickly giving them *Air* again before the *Engine* was quite exhauſted; but I never ſaw any of them *Revive*, that had been in a perfect *Vacuum*.

M. *Guide* did make frequent *Diſſections* of ſuch Animals as we had thus kill'd, and obſerved, amongſt other Things, that their *Lungs* fell to the Bottom in *Water*. He ſaith, that the *Solidity* or *Cloſeneſs* of the *Lungs* of Animals, that have died *in Vacuo*, comes from hence; that the *Blood* which is propelled into the *Lungs* by the *Vena Arterioſa* doth ſo ſtrongly preſs the *Bronchi* of the *Arteria aſpera*, that it expreſſes the *Air* out of them, and glues as 'twere their Sides to one another. But for my part I do not believe, that the Blood of the *Vena Arterioſa* can thus compreſs thoſe *Bronchi*, becauſe that the ſaid *Blood* is incloſed in its Veſſels, that keep and hinder it from compreſſing others. Yet I am not ignorant, that the Things that are included in the *Oeſophagus* do indeed compreſs the *aſperia Arteria*, and that the *aſperia Arteria* by being filled compreſſes alſo the *Oeſophagus*, upon the account of the Situation of theſe two *Conduits*. But it appears not at all, that the ſmalleſt *Ramifications* of thoſe *Bronchi*, and of the *Vena Arterioſa*, are ſituate in the ſame Manner; for the *Bronchi* being harder than the *arterial Vein*, they will compreſs it more eaſily, than be compreſſed by it; and ſo if you ſhould blow them up with Bellows, they will glue the Sides of that Vein together, and hinder the Circulation: Which is directly contrary to the Experiment, as M. *Guide* himſelf obſerveth.

It is therefore far more probable, that if the *Lungs* be compreſſed, that Compreſſion is made by the *Pleura*, which may be ſwelled within the *Breaſt*, as the Skin is ſwell'd without. But it is not neceſſary that the Lungs be compreſſed *in Vacuo* to make them ſubſide in Water; for I have diverſe times put Pieces of Lungs, and whole Lungs in the *Vacuum*, and they remained there extremely ſwell'd; but, as ſoon as the Air was again intromitted, they became very flat and red, and ſunk to the Bottom in Water. Which ſhews, 'tis ſufficient for getting the Air out of the Lungs to render them cloſe and red; and I have not been able to produce this Effect but by means of the exhauſting Engine. For I have left Lungs a whole Night between two Plates with a great Weight upon them, to endeavour to preſs the *Air* out of them, but it would not ſucceed, and thoſe Lungs did ſtill float upon the Water. I have alſo tried to make the Air re-enter into the Lungs, after I had render'd them ſolid in the Engine, and that I found very eaſy; for drawing them out from the Bottom of the Water, I did blow into the *aſpera Arteria*; and the Lungs ſwelled again, and reſumed their ordinary Colour, and floated on the Water. And this is that which befalls the Lungs of *Infants* new born.

A Pneumatical Experiment, by M. Joh. Chr. Sturmius, P. Coll. n. 2. p. 8.

LXXX. I *ſeal'd* up a round Glaſs hermetically, and covered it with a double *Bladder* vary carefully, and including it in a large Receiver, I found, according to my Expectation, that, after about 200 *Exhauſtions* had been made, it broke all in Pieces with a very great noiſe.

LXXXI. Papers, *Of leſs general Uſe*, omitted.

n.251.p.144 1. A Liſt of the *French Academicians* at their new Regulation in the Year 1699. by *M. Geoffry.*

n.99.p.6158 2. An Account of ſome of the *natural Things*, with which the intelligent and inquiſitive Signior *Paulo Boccone*, of *Sicily*, hath lately preſented the *R. S.* and enriched their Repoſitory.

n.246.p.393 3. Remarks by Mr. *Ja. Petiver*, on ſome *Animals*, *Plants*, &c. ſent to him from *Maryland*, by the Reverend Mr. *Hugh Jones.*

n.255.p.295 4. A Catalogue of *Shells*, &c. gathered at the *Iſland of Aſcenſion*, by Mr. *Ja. Cunningham* Surgeon, with what Plants he there obſerved; communicated to Mr. *Ja. Petiver.*

n.248.p.390 n.247.p.461 n.249.p.44. n.250.p.70. 5. An Account of a *China Cabinet*, filled with ſeveral Inſtruments, and ſome *natural Curioſities* of that Country, ſent to the *R. Society*, by Mr. *Buckley*, chief Surgeon at Fort *St. George*; by *Hans Sloane*, M. D.

n.10.p.167. 6. A *Thermoſcope* and a *Baroſcope*, invented by Mr. *R. Boyle*, deſcribed by Dr. *Wallis.*

n.13.p.218. 7. Dr. *Hook's Wheel Barometer*, deſcrib'd in his *Micrography*, is here ſomething improv'd; by himſelf.

n.91.p.5168 8. *Experiments* propoſed, to explicate the Reaſon of the *Suſpenſion* of *Mercury* in the *Torricellian Tubes* at an unuſual Height; by Dr. *Wallis.*

n.206.p.998 9. Some *Queries* concerning the Nature of *Light* and *Diaphancus Bodies*; by Mr. *Edm. Halley.*

n.79.p.3060 10. *Queries* concerning the different Effects of the *Sun*'s Heat collected by a burning Concave, and that of Fire, upon Gold, *&c.* by *P. Fr. Luna.*

n.66.p.2020 11. An *Experiment* concerning the Progreſs of *artificial Conglaciation*, and the remarkable Accidents therein obſerved; by the *Florentine Philoſophers*, and publiſhed in their *Saggi di Naturali Eſperienze.*

n.23.p.424. 12. Propoſals to try the Effects of the *Pneumatical Engine*, exhauſted in *Plants*, *Seeds*, *Eggs* of *Silk-worms*, &c. by Mr. *R. Boyle*, and Dr. *Beale.*

LXXXII. Accounts *and* Emendations of *Books*, omitted.

n.27.p.501. 1. THE Hiſtory of the *Royal Society* of *London*, for the Advancement of *Experimental Philoſophy*; by *Tho. Sprat.*

n.36.p.715. 2. The Progreſs and Advancement of *Knowledge* ſince the Days of *Ariſtotle*, in an Account of ſome of the moſt remarkable late *Improvements* of uſeful Learning; by *Joſ. Glanvill*, *Lond.* 1668. in 8*vo.*

n.8.p.145. ☞ 3. A Narration of the Eſtabliſhment of the *Lyncei*, an *Italian Academy*, and of their *Deſign* and *Statutes.*

n.203.p.886 4. *Diogenes Laertius*, *Græce* & *Latine*, cum commentariis integris Doctorum Virorum. *Amſtel.* 1692.

5. *C. Plinii* Hiſtoria Naturalis. *Notwithſtanding the great Care of* R. P. Harduine, *in this curious* Edition, yet *he hath paſt over ſeveral Faults, three of which Mr.* Halley *hath here* corrected, *viz.* n.194.p.535

(1.) *Lib.* 2. *Cap.* 13. Defectus [*Solis* & *Lunæ*] *Ducentis Viginti Duobus* Menſibus redire in ſuos Orbes certum eſt: *Whereas it ought to be* CCXXIII; *at which Time that* Period *is* compleated; *and the* Moon *returns to the* Sun *and of the ſame* Node *accurately enough, to her* Apogæum *very near; and within a few* Degrees *to the ſame* Place *of the* Heavens.

(2.) *Lib.* 11. *Cap.* 37. Jecur maxime vetuſtatis patiens centenis durare Annis *Obſidionum* exempla prodidere; *which Mr.* Halley *conjectures ſhould either be* Hoc *Seniorum* exempla, or Hoc *Syrorum* exempla prodidere.

(3.) *Lib.* 20. *Cap.* 14. *Inſtead of* Syriation *&* *vomicas vulvæ curavit illa, Mr.* Halley *reads* Satyriaſin *& Vomicas vulvæ curavit.*

6. Pinax rerum *Naturalium Britannicarum*, continens *Vegetabilia*, *Animalia*, & *Foſſilia*, in hac Inſula reperta. Auth. *Chr. Merret*, M. D. n.20.p.364. n.24.p.448.

7. Muſeo Coſpiano anneſſo a quello del famoſo *Uliſſe Aldrovandi*, & donato alla ſua Patria dell' Illuſtriſſimo Signore *Ferdinando Coſpi* Patricio di *Bologna* & Senatore, *&c.* Deſcrizzione di *Lorenzo Legati Cremoneſe.* In *Bologna* 1678. in *Folio.* n. 140. p. 1011.

8. Muſæi *Petiveriani* Centuria Prima; Rariora Naturæ continens: viz. *Animalia*, *Foſſilia*, *Plantas*, ex variis Mundi plagis advecta; ordine digeſta; Nominibus propriis ſignata; & Iconibus Æneis eleganter illuſtrata. *Lond.* 1696. in *8vo.* n.224.p.393.

9. (1.) Saggi di Naturali Experienze, fatte nell *Academia del Gimento*, in *Firenze*, *An.* 1667. in *Folio.* n.33.p.640.

(2.) Eſſays of natural Experiments made in the *Academy del Gimento* under the Protection of the moſt ſerene Prince *Leopold* of *Tuſcany.* *Eſtabliſhed* by the ingenious *Rich. Waller*, Eſq; 1684. in *4to.* n.164.p.757

10. (1.) *Miſcellanea Curioſa* Medico-Phyſica, *Academiæ naturæ curioſorum*, Annus *Primus*, *Lipſiæ* 1670. in *4to.* n.68.p.2070

(2.) Annus *Secundus*; Anni *Scil.* 1671. Jenæ, 1671. in *4to.* n.85.p.5024

(3.) *Ephemeridum* Medico-Phyſicarum *Germaniæ* Annus *Tertius*, &c. *Lipſiæ* & *Francofurti.* 1673. in *4to.* n.101.p.15.

(4.) Annus IV. & V. Anni 1673 & 1675, *&c.* Cum Appendice. *Francofurti* & *Lipſiæ.* 1676. in *4to.* n.129.p.742

11. (1.) *Thomæ Bartholini* Acta Medica & Philoſophica *Hafnienſia*, *An.* 1671 & 1672. *Hafniæ.* 1673. in *4to.* n.97.p.6135

(2.) *An.* 1673. *Hafniæ.* 1675. n.114.p.315

12. *Georgii Hieronymi Velſchii* Hecatoſteæ 2. Obſervationum *Phyſico-Medicarum* Auguſtæ Vindelicorum. 1675. n.127.p.673

13. *Stephani Chauvini* Lexicon Rationale, ſive Theſaurus Philoſophicus, *&c.* *Roterodami.* 1692. in *Folio.* n.199.p.731 A ☞

14. (1.) Collegium *Experimentale* ſive *Curioſum*, in quo Primaria hujus Seculi inventa & Experimenta *Phyſico-Mathematica*, *A.* 1672. quibuſdam Naturæ Scrutatoribus ſpectanda exhibuit, & ad Cauſas ſuas Naturales demonſtrativa Methodo reduxit, *Jo. Chriſtophorus Sturmius Norimbergæ.* 1676. in *4to.* n.121.p.509

(2.) Pars Secunda. *Altorſi.* 1685. in *4to.* n. 175. p. 1184.

15. Ex-

n.92.p.6001 15. Experienze intorno a diverſe *Coſe Naturali*, & particolar mente à quelle che ci ſon portate dall' *Indie*; fatte da *Franceſco Redi* in *Firenzi*. 1671. in 4*to*.

n.207.p.33. 16. *Obſervationi Naturali, ove ſi contengono materie* Medico Fiſiche, *&c.* Natural Obſervations, containing ſeveral *Medico-Phyſical* and *Botanical* Matters; with diverſe *natural Productions*; ſeveral Sorts of *Phoſphori*, *ſubterraneous Fires* in *Italy*, and other curious Subjects; in familiar Letters, by Signior *Paul Boccone*, M. D. *Bononia*, 1684. in 12*mo*.

n.207.p.37. 17. *Muſeo di* Fiſica, *& di* Eſperienze, *arrichito di Figure di* Piante Nove
n.249. p.53. *Oſſervazione, Note Medicinali e Ragionamenti, ſecondo i Principii di Neoterici,*
diſpoſito in Decade VIII. by *S.* Paolo Boccone. Upon this Book Mr. *Ray* adds
here ſome Remarks of his own.

n.73.p.2214 18. *Philoſophus Autodidactus*, exhibitus in Epiſtola, ex *Arabica* in *Latinam* Linguam verſa, ab *Edvardo Pocockio*, *Oxon*. 1671. in 4*to*.

n.69.p.2124 19. *Prodromo* Overo Saggio di alcune Inventioni nouve premeſſo all' *Arte Maeſtra*, di P. *Franciſco Lana S. I.* in *Breſcia*, 1670. in 4*to*.

n.72.p.2179 20. Of the *Uſefulneſs* of *experimental natural Philoſophy*, the ſecond *Tome*; by the honourable *Robert Boyle*, Eſq. *Oxon*. 1671. in 4*to*.

n.103. p.53. 21. About the Excellency and Grounds of the *Mechanical Hypotheſis*, ſome Conſiderations occaſionally propoſed to a Friend. by *R.B. E. Lond.* 1674. in 4*to*.

n.181.p.116 22. A free Enquiry into the vulgarly receiv'd Notion of *Nature*; by the Hon. *R. Boyle*, Eſq; *Lond*. 1686. in 8*vo*.

n.40. p.810. 23. *Ren des Cartes* Epiſtolæ; Pars *Prima* & *Secunda*. *Lond*. 1668 in 4*to*.

n.22. p.392. 2. Le Tome *Troiſieme* & Dernier des *Lettres* de M. *des Cartes*.

n.54.p.1094 24. Le *Syſtem General* de la *Philoſophie*; per *Francois Bayle*. M.D. A *Tholouze*, 1696. in *Fol.*

n.62.p.2034 25. A Diſcourſe in Vindication of *Des Cartes*'s *Syſtem*; by Mr. *Des Fourneillis:* To which is annexed, the *Syſtem General* of the ſame *Carteſian* Philoſophy, by *Francis Bayle*, M. D. *Lond*. 1670.

n.70.p.2137 26. *Philoſophia Veterum*, è Mente *Renati des Cartes* breviter digeſta; ab *Antonio le Grand*. *Lond*. 1670. in 12*mo*.

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n.108.p.192 *Cartes*, nova Methodo adornata, & explicata. *Lond*. 1672. in 8*vo*.

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n.123.p.570 29. De conſenſu *Vet. & Novæ Philoſophiæ*, Lib. 4. ſeu Promotæ per *Experimenta Philoſophiæ* pars *prima:* Auth. *J. B. du Hamel*. P. S. L. in 12*mo*.

n.65.p.2105 30. (1.) De *Corporum Affectionibus* cum manifeſtis tum occultis, Libri 2 ſeu
Promotæ per *Experimenta Philoſophiæ* Specimen, Auth. *J.B. du Hamel*. Paris,
Ibid.p.2106 1670. in 12*mo*. *Mr.* Boyle's *Diſcourſe* (*in his* Origin of Forms and Qualities,)
concerning the Neceſſity of the Creator's Concourſe *in the* Preſervation *of all*
Things, *being miſunderſtood by Mr.* Du Hamel, *is here* explained.

n.98.p.6151 (2.) De *Corpore Animato*, Libri 4. ſeu Promotæ per *Experimenta Philoſophiæ* Specimen alterum: Auth. *Joh. Baptiſta du Hamel*. P.S.L. *Pariſiis*, 1673. 12*mo*.

n.131.p.790 31. Clavis *Philoſophiæ* Naturalis, *Ariſtotelica Carteſiana*; Editio ſecunda, aucta Opuſculis Philoſophicis varii Argumenti; quibus Errores Scholarum paſſim deteguntur, ac veritas *Philoſophiæ*, quam *Carteſianam* vocant, confirmatur, Auth. *Jo. de Raei*. *Amſt*. 1677. in 4*to*.

32. Elementa *Phyſica*, ſive nova *Philoſophiæ* Principia; ubi *Carteſianorum* Principiorum Falſitas oſtenditur, ipſiuſque Errores ac Paralogiſmi ad Oculum demonſtrantur, ac refutantur; a *Fran. Willhelmo* Libero Barone de *Nuland*, &c. *Hagæ Comitis*, 1669. in 12*mo*. n.65.p.2007

33. Placita Philoſophica *Guarini*. n.20.p.365.

34. *Phyſica* in Decem Tractatus Diſtributa; Auth. *Honorato Fabri*. S. J. *Lugd. Gal.* 1669. in 4*to*. n.68.p.2082

35. *Honorati Fabri* S. J. Tractatus duo; quorum Prior eſt de *Plantis* & de *Generatione Animalium*; Poſterior de *Homine*. n.18.p.325.

36. Traite de *Phyſique* par *Jaques Rohault*. A *Paris* 1671. in 4*to*. n.70.p.2138

37. Propoſitiones *Hydroſtaticæ* ad Illuſtrand. *Ariſtarchi Samii* Syſtema deſtinatæ, & quædam *Phenomena Naturæ* generalia. Auth. *Franciſco Jeſſop* Arm. *Lond.* 1687. in 4*to*. n.191.p.440

38. *Caſp. Bartholini* Thom. F. Specimen *Philoſophiæ Naturalis*. Accedit, de *Fontium Fluviorumque Origine*, Diſſertatio Phyſica. *Amſtelodam.* 1697. in 12*mo*. n.237.p.62.

39. *Thomæ Cornelii Conſentini* Progymnaſmata *Phyſica*. n.30.p.579.

40. Les Eſſays *Phyſiques* du Sieur *de Launay*.

41. *Eraſmi Bartholini* de *Naturæ* Mirabilibus Quæſtiones Academicæ. *Hafniæ*, 1674. in 4*to*. n.30.p.579.

42. Decameron *Phyſiologicum*: Or ten Dialogues of *natural Philoſophy*. To which is added the Proportion of a ſtrait Line, equal to half the Arch of a *Quadrant*. By Mr. *Hobbs*. n.107.p.159 n.138.p.965

43. Coſmopœia Divina, ſeu *Fabrica Mundi* explicata, per *Ludov. de Beaufort*. M. D. *Lugd. Batav.* 1656. in 4*to*. n.59.p.1052

44. *Carteſius Moſaizans*; Auth. *Joh. Amerpoel Leowardiæ*. 1669. in 12*mo*. Ibid. p.1053.

45. The Divine Hiſtory of the *Geneſis* of the *World* explicated and illuſtrated *Lond.* 1670. in 4*to*. n.60.p.1083

46. A Treatiſe of the *Bulk* and *Selvage* of the *World*, &c. by *Nath. Fairfax*, M. D. *Lond.* 1673. n.99.p.6172

47. *Telluris Theoria ſacra*. Authore *T. Burnetio*. *Lond.* 1681. in 4*to*. *PhCol*3.p.75

48. *Archeologiæ Philoſophicæ*, ſive Doctrina Antiqua de *Rerum Originibus*; Libro duo. Auth. *Tho. Burnet*. *Lond.* 1692. n.201.p.769

49. Conſiderations on a Book, entituled, *The Theory of the Earth*: Publiſhed ſome Years ſince by the Learned Doctor *Tho. Burnet*. Written by *Jo. Burnet*, Jun. Gent. n.203.p.888

50. The Wiſdom of God manifeſted in the *Works* of the *Creation*, in 2 Parts. By Mr. *J. Ray*. *Lond.* 1692. in 8*vo*. n.196.p.611

51. Three Phyſico Theological Diſcourſes, concerning, 1. The *Primitive Chaos*, and *Creation* of the *World*. 2. The *General Deluge*, its Cauſes and Effects. 3. The *Diſſolution* of the *World*, by Mr. *J. Ray*. *Lond.* 1692. in 8*vo*. Ibid. p.625.

52. The Prodromus of a Diſſertation concerning a *Solid* contained in a *Solid*, by *Nicholaus Steno*. *Engliſh'd* out of *Latin*. *Lond.* 1671. in 8*vo*. n.72.p.2186

53. An Eſſay toward a *natural Hiſtory* of the *Earth*, and terreſtrial Bodies, eſpecially *Minerals*: As alſo of the *Sea*, *Rivers*, and *Springs*. With an Account of the *univerſal Deluge*, and of the Effects it had upon the *Earth*. By *J. Woodward*, M. D. *Lond.* 1695. in 8*vo*. n.217.p.115.

n.219.p.181, 199. 54. La vana ſpeculatione diſingannata dal ſenſo: Lettera reſponſiva circa *i Corpi Marini*, che *Petrificati* ſi travano in varii Luoghi Terreſtri. *Di Agoſtino Scilla* Pittore Academico della *Fucina*, in Napoli, 1670. in 4*to*. *This Book is here* abridg'd, *ſome ſhort* Notes *added, and ſome of the* Author's Figures *annexed and explained by two of the* Fellows *of the* Royal Society.

n.8.p.145. n.11.p.191. 55. (1.) The Origin of *Forms* and *Qualities* illuſtrated by Conſiderations and Experiments; by the Hon. *Robert Boyle*, Eſq;

n.66.p.2044 (2) The ſame in *Latin*. *Oxon*. 1669. in 12*mo*.

n.28.p.532. 56. Free Conſiderations about *ſubordinate Forms*; by the Hon. *Robert Boyle.*

n.63.p.2057. 57. Tracts written by the Hon. *Rob. Boyle*, about the *coſmical Qualities* of Things; the Temperature of the *ſubterraneal* and *ſubmarine Regions*; and the *Bottom* of the *Sea*; together with an Introduction to the Hiſtory of *particular Qualities*. *Oxon*. 1670. in 8*vo*.

n.127.p.669. 58. Experiments, Notes, *&c.* about the *Mechanical* Origin of diverſe *particular Qualities:* Among which is inſerted a Diſcourſe of the Imperfection of the *Chymiſts Doctrine* of *Qualities*; together with ſome Reflections upon the *Hypotheſis* of *Alcali* and *Acidum*. By the Hon. *Robert Boyle*, Eſq; *Lond.* 1675. in 8*vo*.

n.130.p.766 59. *Roberti Boyle* Nobiliſſimi *Angli* & *Soc. Regiæ* digniſſimi *Socii*, Opera varia. *Genevæ*, 1677. in 4*to*. *This Edition and Tranſlation* is here complained of *for ſeveral Reaſons*.

n.53.p.1069 60. Certain *Philoſophical Eſſays*, and other Tracts by the Hon. *Rob. Boyle.*

n.162.p.702 61. Experiments and Conſiderations about the *Poroſity* of *Bodies*, in two Eſſays; by the Hon. *Robert Boyle*, Eſq; *Lond*. 1684. in 8*vo*.

n.96.p.6101 62. Several Tracts written by the Hon. *Rob. Boyle*, of the ſtrange Subtility, Efficacy, and determinate Nature of *Effluviums*; of new Experiments to make the Parts of Fire and Flame ſtable and *ponderable*; together with ſome additional Experiments about Arreſting and Weighing of *igneous Corpuſcles*; as alſo a Diſcovery of the *Perviouſneſs* of Glaſs to ponderable Parts of Flame, with ſome Reflections on it by way of Corollary.

n.150.p.982 63. An Eſſay of the great Effects of even *languid* and *unheeded Motions*. *Lond.* 1685.

n.1.p.8. n.3.p.46. 64. New Obſervations and Experiments, in order to an *experimental Hiſtory* of *Cold*, by the Hon. *Robert Boyle*, Eſq;

n.78.p.3043 65. Diſſertations ſur la Nature du *Froid* & du *Chaud*, par le Sieur *Petit*. Avec un Diſcours ſur la Conſtruction & l'Uſage d'un *Cylindre Aritimetique* invente par le meſme Autheur. A *Paris*, 1671.

n.267.p.724 66. Thaumantiadis Thaumaſia, ſub Præſidio Dom. *Chr. Sturnii*. *Noribergæ*, 1699.

n.42.p.845. 67. A *Continuation* of new Experiments Phyſico-Mechanical, touching the Spring and Weight of the Air, and their Effects; the I. *Part*, *&c.* by the Hon. *Rob. Boyle*, F. R. S. *Oxon*. 1668. in 4*to*.

n.50.p.1017 68. *Georgii Sinclarii* Ars Nova & Magna *Gravitatis* & *Levitatis*. *Roterodami*. 1669. in 4*to*.

n.92.p.5199 *Some Complaints and Suggeſtions by that Author, (in his Preface) are here* anſwer'd.

69. Dimoſtratione Fiſico-Matematica Delle ſette Propoſitioni, che promeſſe *Donato Roſetti*, in *Firenze* 1668. in 4*to*. n.65.p.213.

70. Obſervations touching the *Torricellian Experiment*, and the various Solutions of the ſame, eſpecially touching the *Weight* and *Elaſticity* of the *Air*. *Lond.* 1674. in 8*vo*. n.104. p.789

71. Tracts written by the Hon. *Rob. Boyle*, of a Diſcovery of the admirable *Rarefaction* of the *Air* (even without *Heat*;) New Obſervations about the *Duration* of the *Spring* of the *Air*; New Experiments touching the *Condenſation* of the *Air* by mere Cold; and its Compreſſion without *Mechanical Engines*: And the admirably differing *Extenſion* of the ſame Quantity of *Air rarified* and *compreſſed*. *Lond.* 1670. in 4*to*. n.67.p.205

72. Tracts, written by the Hon. *Rob. Boyle*, containing new Experiments touching the Relation betwixt Flame and Air, and about two Exploſions: An Hydroſtatical Diſcourſe, occaſioned by ſome Objections of Dr. *Hen. More*, &c. To which is annexed an Hydroſtatical Letter, about a way of weighing Water in Water: New Experiments of the *Poſitive* or *Relative Levity* of Bodies under Water; of the *Air's Spring* on Bodies under Water; and about the differing Preſſure of heavy *Solids* and *Fluids*. *Lond.* 1672. in 8*vo*. n.92.p.5197

73. Tracts, conſiſting of Obſervations about the *Saltneſs* of the *Sea*: An Account of a *Statical Hygroſcope* and its Uſes; together with an Appendix about the Force of the Air's Moiſture: and a Fragment about the *Natural* and *Præternatural State* of Bodies, by the Hon. *Rob. Boyle*. To all which is premiſed a *ſceptical Dialogue* about the *poſitive* or *privative* Nature of Cold: By a Member of the *R. Society*. *Lond.* 1673. in 8*vo*. n.97.p.6127

74. Tracts, containing, (1.) Suſpicions about ſome hidden Qualities of the *Air*, with an Appendix touching *celeſtial Magnets* and ſome other Particulars. (2.) Animadverſions upon Mr. *Hobbs*'s *Problemata de Vacuo*. (3.) A Diſcourſe of the Cauſe of *Attraction* by *Suction*: By the Hon. *Rob. Boyle*, Eſq; *Lond.* 1674. in 8*vo*. n.110.p.236

75. A Diſcourſe concerning the Origin and Properties of Wind, &c. by *R. Bohun*. *Oxon.* 1671. in 8*vo*. n.90. p.514.

76. Aero-Chalinos, or a Regiſter for the Air, &c. by *Nath. Henſhaw*, M. D. *Lond.* 1677. in 12*mo*. n.133.p.834

CHAP. II.

Hydrology.

I. TAKE a Globe of Fir or Maple, or other light Wood, as *A*; let it be well ſecured by Varniſh, Pitch, or otherwiſe, from imbibing Water; then take a Piece of Lead, or Stone, *D*, conſiderably heavier than will ſink the Globe: Let there be a long Wire Staple *B* in the Ball *A*, and a ſpringing Wire *C* with a bended End *F*, and into the ſaid Staple preſs in with your Fingers the ſpringing Wire on the bended End; and on it hang the Weight *D* by

To ſound the Depth of the Sea without a Line; by Dr. Hook.
n. 3. p. 147.
n.24.p.439.

Fig. 45. *D* by its Hook *E*, and ſo let Globe and all ſink gently into the Water, in the Poſture repreſented in the *Figure*, to the Bottom, where the Weight *D* touching firſt is thereby ſtopt; but the Ball, being by the Impetus it acquired in deſcending carried downwards a little after the Weight is ſtopt, ſuffers the ſpringing Wire to fly back, and thereby ſets itſelf at Liberty to re-aſcend. And by obſerving the Time of the Ball's Stay under Water, which may be done by a Watch having Minutes and 2*ds*, or by a good Minute-Glaſs, or beſt of all by a Pendulum vibrating ſeconds; the which muſt be three Foot, three Inches, and one fifth of an Inch long, *viz.* between the Middle of the Bullet and the upper End of the Thread, where it is faſtened or held when it vibrates, you may, with the help of ſome Tables, come to know any *Depth* of the *Sea.*

Note, That Care muſt be had of proportioning the Weight and Shape of the Lead to the Bulk, Weight, and Figure of the Globe, after ſuch a Manner, as upon Experience ſhall be moſt convenient.

In ſome of the Tryals already made with this *Inſtrument*, the Globe being of Maple-wood, well covered with Pitch to hinder ſoaking in, was $5\frac{1}{6}$ Inches in Diameter, and weighed $2\frac{1}{2}$ *Pounds*; the Lead, of $4\frac{1}{2}$ *Pounds Weight*, was of a *Conical* (but is now uſed of a *Globous*) Figure 11 *Inches* long, with the ſharper End downwards, $1\frac{2}{16}$ at the Bottom in Diameter. And in thoſe Experiments made in the *Thames*, in the Depth of 19 Foot Water, there paſſed between the Immerſion and Emerſion of the Globe 6 *Seconds* of an Hour; and in the Depth of 10 *Foot* Water there paſſed $3\frac{1}{2}$ Seconds or thereabouts.

In the ſame Tryal it was alſo found, that there was no Difference in Time between the Submerſions of the Ball at the greateſt Depth, when it roſe two Wherry's Length from the Place where it was let fall, being carried by the Current of the Tide, and when it roſe only a Yard, or ſo, from the ſame place where it was let down: And that it muſt be ſo, in great Depths and ſtronger Currents, is as certain, as eaſy to be demonſtrated.

And if it be alledged, that it muſt be known, when a light Body aſcends from the Bottom of the Water to the Top, in what Proportion of Time it riſes; it may be conſidered, that in this Experiment the Times of the Deſcent and Aſcent are both taken and computed together; ſo that, for this Purpoſe, there needs not the Nicety which is alledged.

Of other Experiments of this way of *ſounding* without a *Line*, made by the Noble Lord Viſcount *Brounker*, Sir *Robert Moray*, Knight, and Mr. *Hook*, in the Channel at *Sheerneſs*, the following Account was given; *viz.*

	Ounces,	*Grains.*
A wooden Ball *A* weighed—	$52\frac{2}{16}$	00
Another wooden Ball *B* —	30	22
A Lead *A*————	30	00
Another Lead *B*————	$30\frac{1}{4}$	00

The Ball *B*, and the Lead *B*, were let down at 16 Fathom; and the Ball returned in 48 ſingle Strokes of a *Pendulum*, held in the Hand, *vibrating* 58 ſingle Strokes in a Minute.

A ſecond Time repeated with the ſame Succeſs; therefore the Motion was 4 Foot every ſecond.

Again, the Ball *A*, and the Lead *B*, whoſe Nail was bended into a ſharper Angle; the Ball returned in 39 Strokes. A ſecond Time repeated with the ſame Succeſs at the ſame Depth.

Ball *B*, Lead *B*, in which Tryal the Line not being clear, ſtopped a little the Motion; the Ball returned in 47 at the ſame Depth.

Ball *A*, Lead *A*, at 8 Fathom and 1 Foot, returned at 20; repeated at 8 Fathom, returned at 19.

Tried the *third* Time at 10 Fathom and 4 Foot, returned at 28.

A *fourth* Tryal at the ſame Depth, juſt the ſame.

At a *fifth*, at 10 Fathom 5 Foot, returned at 27.

A *ſixth* Tryal juſt the ſame.

A *ſeventh* at 12 Fathom 5 Foot, returned in 37.

An *eighth* Tryal juſt the ſame.

Another Day near the ſame Place.

Note, That the *Pendulum* was this Day adjuſted, and made a little ſhorter, there having been but 58 *Vibrations* in a Minute the other Day.

Ball *A*, Lead *B*, at 14 Fathom, returned in $32\frac{1}{2}$.

A ſecond Tryal a little after, in the ſame Place, returned in 33. In the making of which Tryal the *Vibrations* were told aloud, and the Lead having been let down by a Line, was found to touch the Bottom in juſt half the Time the Ball ſtaid under Water. By a ſecond Tryal, the aſcending and deſcending was found to be in equal Times. And by a third Tryal, with another Lead, the very ſame found, *viz.* $16\frac{1}{2}$ deſcending, and $16\frac{1}{2}$ aſcending. This Lead and Ball let down without a Line, the Ball returned in 13 *Vibrations*; a Sign it went not to the Bottom.

Fig. 46. A Tryal made with a Lead, whoſe Iron Crook was faſten'd at the Top of it, ſucceeded very well, and the Ball returned in $34\frac{1}{2}$: But, by reaſon of the Current, the Experimenters could not perceive when the Lead touched the Bottom. This Lead being let down without a Line, the Ball returned in $32\frac{1}{2}$. The Depth of Water was now found by the Ship's Lead, to be 14 *Fathom*.

Fig. 47. Another Tryal was made with a Line, bowing the Point of the Lead, and the Ball returned in 34. The ſame let down without a Line, the Ball returned in 6 or 7 *Vibrations*; a Sign again it went not to the Bottom. In a Tryal with another Lead, the Ball returned in 34. Repeated again with the ſame Succeſs.

Fig. 48. In a Tryal with a Lead, whoſe Nail was ſet awry, the Ball returned in 34. After which Tryal the Depth was found to be juſt 14 Fathom. The laſt Lead and Ball being let down without a Line, the Ball returned at 35. In another Tryal, with a Lead that never failed, the Ball returned in 34, and the Lead touched the Bottom at 17.

By a Tryal with another Lead, the ſame Time was found exactly.

By a 3d Tryal with this laſt, the very ſame.

Theſe Tryals were made near about high Water, at the Depth of 14 *Fathom* juſt by Meaſure; and in them the Motions ſeem to be 5 *Foot* every *Second.*

In all theſe Tryals the greateſt Difficulty was, in the Uſe of Conical Figures with Iron Crooks, to bend the Iron that it might be ſure to carry down the Ball with it to the Bottom, and when come thither to let it go: For almoſt every one of theſe Leads failed in one of theſe Requiſites, 'till by ſeveral Tryals they had been adjuſted.

It is not to be omitted, that the laſt Tryals being made near High-water, the Ball was found to riſe (by the Boat being permitted to drive) far off upon one Side, out of the Way, juſt as any light Thing, ſuffered to ſwim on the Water, would be carried; which ſeemed to argue a Motion of the Underparts of the Water, differing from that of the Upper (a thing which is ſaid to be at certain Times of the Tides, both at the Mouth of the *Sound*, and of the *Streights*; which deſerves to be farther inquired into.) The Angle, made by theſe different Motions, ſeemed to be about 40 *gr.*

To fetch up Water from any Depth; *By* Dr. Hook n. 9. p. 149. n. 24. p. 447. *Fig.* 49.

II. Let there be made a ſquare wooden Bucket *C*, whoſe Bottoms *E E* are ſo contrived, that as the Weight *A* ſinks the Iron *B*, to which the Bucket *C* is faſtened by two Handles *D D*, on the End of which are the moveable Bottoms, or Valves *E E*, and thereby draws down the Bucket; the Reſiſtance of the Water keeps up the Bucket in the Poſture *C*, whereby the Water hath, all the while it is deſcending, a clear Paſſage through; whereas, as ſoon as the Bucket is pulled upwards by the Line *F*, the Reſiſtance of the Water to that Motion beats the Bucket downward, and keeps it in the Poſture *G*, whereby the included Water is kept from getting out, and the ambient Water kept from getting in.

By the Advantage of this Veſſel you may come to know the Conſtitution of the Sea-water in ſeveral Depths; and whether it be ſalter at and towards the *Bottom*.

Directions for obſerving Tides; By Sir Rob. Moray. n. 17. p. 198.

III. 1. To obſerve in what Proportion the Increaſes of the Tides from the Neap to the Spring Tides, and their Decreaſes, and the Riſings and Fallings of the Ebbs, happen to be in regard to one another; it is ſuppoſed upon ſome Obſervations, made by Sir *Rob. Moray* (though not throughly and exactly performed,) that theſe Increaſes are in the Proportion of Sines; the firſt Increaſe exceeding to the loweſt in a ſmall Proportion; the next in a greater; the 3d greater than that; and ſo on to the Midmoſt, whereof the Exceſs is greateſt, diminiſhing again from that to the higheſt Spring Tide; ſo as the Proportions before and after the Middle do greatly anſwer to one another, or ſeem to do ſo.

2. To obſerve the Increaſe and Decreaſe of the *Velocity* of the *Current*; which is alſo ſuppoſed to be according to the Proportion of Sines.

3. The exact Meaſures of the Heights of every utmoſt High-Water and Low-Water from one Spring-Tide to another.

4. The exact Heights of Spring-Tides and Spring-Ebbs.

In order to all which this following *Apparatus* is propoſed to be made uſe of. In ſome convenient Place upon a Wall, Rock, or Bridge, *&c.* let there be an *Obſervatory* ſtanding as near as can be to the Brink of the Sea, or upon ſome Wall; and if it cannot be well placed juſt where the Low-Water is, there may be a Channel cut from the *Low-Water* to the *Bottom* of the *Wall*, *Rock*, &c. The *Obſervatory* is to be raiſed above the *High-Water* 18 or 20 *Foot*, and a Pump of any reaſonable Dimenſion placed perpendicularly by the Wall, reaching above the *High-Water* as high as conveniently may be. Upon the top of the Pump a Pulley is to be faſtened, for letting down into the Pump a Piece of floating Wood, which, as the Water comes in, may riſe and fall with it. And becauſe the riſing and falling of the *Water* amounts to 60 or 70 Foot, the *Counterpoiſe* of the *Weight*, that goes into the Pump, is to hang upon as many Pulleys as may ſerve to make it riſe and fall within the Space by which the *Height* of the Pump exceeds the *Height* of the *Water*. And becauſe by this Means the *Counterpoiſe* will riſe and fall ſlower, and conſequently by leſs Proportions than the *Weight* itſelf, the firſt Pulley may have upon it a Wheel or two, to turn the *Indexes* at any Proportions required, ſo as to give the *minute Parts* of the *Motion*, and Degrees of Riſings and Fallings. And becauſe if the Hole, by which the *Water* is let into the *Pump*, be as large as the Bore of the *Pump* itſelf, the *Weight* that is raiſed by the *Water* will riſe and fall with an *Undulation* according to the *Inequality* of the Sea's Surface, 'twill therefore be fit that the Hole, by which the *Water* enters, be leſs than half as big as the Bore of the Pump; any Inconvenience that may fall thereupon, as to the *Periods* and *Stations* of the Flood and Ebb, not being conſiderable.

5. To obſerve the Poſition and Strength of the Wind, the State of the *Weather*; the *Heights* of the *Barometer*, *Thermometer*, *Hygroſcope*, and the *Moon's Age* and *Place* in all Reſpects.

Tides obſerved at London, by Mr. Hen. Philips, n. 34. p. 656.

IV. 1. The true time of the Tides at all times of the *Moon* is very rudely and ſlightly reckoned up by moſt *Seamen* and *Aſtronomers*; moſt of them reckoning, as if the *Moon* being upon ſuch a *ſet Point* of the *Compaſs* (as the Seaman calls it) or ſo many Hours paſt the *Meridian* (as the *Almanack-makers* reckon) it were *High-Tide* in ſuch and ſuch a *Port* at all times of the *Moon*. And thus they reckon the *Tides* every Day to differ conſtantly 48 *Minutes*. As for Inſtance, a *South-Weſt-Moon* makes a full Tide at *London*, that muſt be underſtood that it is *High-Tide* at *London*, when the Moon is 3 Hours paſt the *Meridian*. Now this is true indeed at *new* and *full Moon*, but not at other times of the *Moon*, which few take any notice of: Only Mr. *Booker* indeed uſed to give this *Caveat*, that about the firſt and laſt *Quarters* of the *Moon* the *Neap-Tides* did not flow ſo long as the *Spring-Tides* by one *Point* of the *Compaſs*; but he gives no Rule to proportion the Difference.

But, obſerving this more narrowly, I find, that at *London* the Tides fall out at the leaſt *Two Points*, that is an Hour and a half, ſooner in the *Quarters*, than in the *new* and *full Moon*. I have alſo found by many Tryals, that the true Time of the Tides might be found to be ſomewhat ſhorter and ſhorter, from the *new* and *full Moon* unto the *Quarters*, yet not in an equal manner, neither gradually decreaſing from the *new* and *full Moon* until the *Quarters*; but rather, that there was ſome little Difference of Alteration both at the *new* and *full Moons*, and alſo at the *Quarters*, and that the greateſt Difference fell out in the midſt between them, agreeing very well to a *circular Proportion* after this Manner.

Fig. 50. 1. Divide a Circle into 12 equal Parts or Hours, according to the Moon's Motion, or Diſtance from the Sun from the *new Moon* to the *full*.

2. Let the *Diameter* of the Circle be divided into 90 Parts or Min. that is, according to the Time of the Difference of Tides between the *new* or *full Moon*, and the *Quarters*, which is one Hour and an half.

3. Make perpendicular Lines croſs the *Diameter* of the Circle from Hour to Hour.

4. Reckon the Time of the Moon's coming to the South in the Circumference of the Circle, and obſerve the perpendicular Line that falls from that Point upon the *Diameter*; and the proportional Min. cut thereby, will ſhew how many Hours or Min. are to be ſubſtracted from the time of high Tides at the *new* and *full Moon*, that ſo you may have the true time of the Tides that preſent Day.

For *Example*; At *London*, on the Day of *new* and *full Moon*, it is high Tide at 3 of the Clock, that is, when the Moon is 3 Hours paſt the Meridian, and ſo by the common Rule, the Moon being about 4 Days old, it will be S. about 3 of the Clock, and it will be high Tide 3 Hours afterwards, that is, at 6 of the Clock. But now, by this Rule, if you count this Time of the Moon's coming to the South in the Circumference, the perpendicular Line, which comes from 3 to 9, cuts the *Diameter* at 45 Min. which ſhews, that ſo much is to be abated from the time of high Tide in the *new* and *full Moons*; ſo that it is high Tide 45 Min. before 6 of the Clock; that is, at 5 Hours 15 Min. and not at 6 of the Clock, according to the common Rule.

The like you may do for any other *Port* or *Place*, knowing the time of *high Water* at the new and full Moon in that Place: And you may do it the more readily, if you ſet down the time of *high Water* at the new and full Moon under the *Diameter*, as I have done for *London*, where it is high Tide at 3 of the Clock: So that, when the Moon is South at 3 of the Clock, the Perpendicular cuts the Diameter at 2 Hours 15 M. and ſo when the Moon is South at 9 of the Clock, by adding 2 Hours 15 Min. you may have the Time of *high Water*, which is 11 of the Clock and 15 Min.

And thus you may eaſily make a Table, which by the Southing of the Moon ſhall readily tell you the time of high Tide at any time of the Moon, as I have done here for *London*: To which all other Places may be reduced to correſpond.

Moon South.		*Tide London.*		*Moon South.*		*Tide London.*		*Moon South.*		*Tide London.*		*Moon South.*		*Tide London.*	
H.	*M.*	*H.*	*M.*	*H.*	*M.*	*H.*	*M.*	*H.*	*M.*	*H.*	*M.*	*H.*	*M.*	*H.*	*M.*
XII.	0	3	0	III.	0	5	15	VI.	0	7	30	IX.	0	11	15
	10	3	9		10	5	21		10	7	41		10	11	29
	20	3	18		20	5	27		20	7	52		20	11	43
	30	3	27		30	5	33		30	8	3		30	11	57
	40	3	36		40	5	39		40	8	14		40	12	11
	50	3	45		50	5	45		50	8	25		50	12	25
I.	0	3	54	IV.	0	5	52	VII.	0	8	36	X.	0	12	37
	10	4	2		10	5	59		10	8	48		10	12	50
	20	4	9		20	6	6		20	9	0		20	1	3
	30	4	16		30	6	13		30	9	13		30	1	16
	40	4	23		40	6	20		40	9	26		40	1	29
	50	4	30		50	6	28		50	9	39		50	1	42
II.	0	4	37	V.	0	6	36	VIII.	0	9	52	XI.	0	1	52
	10	4	44		10	6	44		10	10	5		10	2	3
	20	4	51		20	6	53		20	10	19		20	2	16
	30	4	57		30	7	2		30	10	33		30	2	27
	40	5	3		40	7	11		40	10	47		40	2	38
	50	5	9		50	7	20		50	11	01		50	2	49

Theſe Things I have found to fall out right at *London* for many Years, and ſo I ſuppoſe they may in other Places; if the Difference be not ſo much between the *Neap-tides* and *Spring-tides* in other Places, the Diameter muſt be divided into fewer Parts.

By Mr. Flamſteed, n. 143. p. [illegible]

2. Having taken notice that the Tides ſeldom hold out ſo long as Mr. *Philips*'s Calculation gives them, I obſerved them myſelf more diligently, and with the Help of my Friends and Servants I noted the Times of above 80 high Waters at *Tower-wharf* and *Greenwich*, whereby I found that the greateſt and leaſt Differences betwixt the Moon's true Southing and the high Waters were not, as Mr. *Philips* had placed them, at the full or new and Quarter Moons, but the greateſt nearer to the *Neaps*, the leaſt to the higheſt Spring-tides. I found alſo, that the Inequality was not the ſame that he had made it; and, after a Tryal or two, that I could repreſent and anſwer above 60 of theſe Obſervatious with leſs than one Quarter of an Hour's Difference; which, conſidering how difficult it is to determine the time of an High-Water exactly, I cannot but eſteem a very good Agreement.

3. At the Bar of *Dublin*, on the new and full Moons, a *S. S. E.* Moon makes High-Water, that is, at half an Hour paſt Ten.

At Dublin *by Mr.* W. Molineux, n. 184. p. 193.

At *Rings-end*, at 3 Quarters after 10.

At the *Cuſtom-houſe* at *Dublin*, at 11.

On the Quarter Days.

High-Water on the *Bar*, at 5 a Clock.

At *Rings-end*, at a Quarter paſt 5.

At the *Cuſtom-houſe*, half an Hour paſt 5.

A *Southerly Wind* between S. S. E. and S. S. W. blowing freſh, makes it flow near half an Hour longer than its uſual Courſe.

N. B. That this Obſervation makes the Tides, upon the *Quarter-Moons*, come in later, in reſpect of the *Moon's Southing*, than upon *new* and *full Moons* by half an Hour; whereas in the River of *Thames*, as high as *London*, the *Quarter-Moons* make *High-Water* above an Hour and Quarter ſooner in that reſpect, than the *new* and *full*; as may be ſeen in the accurate Tide-Tables of Mr. *Flamſtead*; but it is from hence evident, that the ſame Tables are not applicable to the *Sea-Ports*, where there is not the ſame Reaſon for the Anticipation of the *Neap-Tides* upon the *Quarter-Moons*.

The Cauſe of this *Phænomenon* ſeems to be, that the *Impulſe* of the Ocean in the *Quarter-Moons* is not ſo vigorous as in the *new* and *full*, nor the Motion of the Waters ſo quick, (as is evident by daily Experience:) Whence it comes to paſs, that in the open Sea, and in Ports upon the Sea-Coaſt, as this of *Dublin*, the High-Water time falls out later than when the Motion is more rapid in the *new* and *full*; but, on the contrary, in Rivers, at any conſiderable Diſtance from the Sea, the Reſiſtance of the Weight of the freſh Water, which is kept ſuſpended during the time of the Flood, is longer overcome by the more potent *Impetus* in the *new* and *full*, than by the weaker in the *Quadratures*; and from hence this Difference ſhould be ſtill more and more conſiderable, as the Port is farther remov'd from the Sea.

Nigh Plimouth, *by Mr.* Sam. Colepreſs, n. 33. p. 632

4. Our *diurnal Tides* from about the latter End of *March* till the latter End of *September* are about a Foot higher (perpendicular, which is always to be underſtood) in the Evening than in the Morning, that is, in every Tide that happens after 12 in the Day, before 12 at Night. On the contrary, the Morning Tides from *Michaelmas* till our *Lady-Day* in *March* again are conſtantly higher by about a Foot, than thoſe that happen in the Evening. And this Proportion holds in both after the gradual Increaſe of the Tides Riſing from the *Neap* to the higheſt *Spring*; and the like Decreaſe of its Height till *Neap* again is deducted.

The higheſt *menſtrual Spring-Tide* is always the *third Tide* after the *new* or *full Moon*, if a croſs Wind do not keep the Water out, as the *N. E.* or *N. W.* uſually doth; whoſe contrary Wind, if ſtrong, commonly makes thoſe to be High-Tides upon our Southern Coaſts which otherwiſe would be but low.

The higheſt *Springs* make the loweſt *Ebbs*. (Tho' I am informed by an expert *Waterman*, that it ſometimes happens, that there may be a very low *Ebb*, tho' no high Spring, which they term an *Out-let*, or *Gurges* of the Sea; as when a great Storm chances off at Sea, and not on the Land.)

The Water neither flows nor ebbs alike in reſpect of equal Degrees; but its *Velocity* increaſeth with the *Tide* till juſt at *Mid-Water*, that is, *half flown*, or at half Flood, at which time the *Velocity* is ſtrongeſt, and ſo decreaſeth proportionably 'till high Water, or full Sea. As may be gueſſed at by the following Scheme collected by Obſervations made at ſeveral Times and Places. And although it be reſtrained to *Plymouth Haven*, or the like, where the Water riſeth about 16 *Foot* (I ſay uſually, becauſe it may vary in this Port from the *loweſt Neap* to the *higheſt Annual Spring* above 7 or 8 *Foot*) yet it may indifferently ſerve for other Places, where it may riſe as many Fathom, or not ſo high, by a proportional Addition or Subſtraction.

	Time.		*Height.*	
	h.	'	*f.*	*inch.*
Flowing	1	0	1	6
	2	0	2	6
	3	0	4	0
	4	0	4	0
	5	0	2	6
	6	0	1	6

	Time.		*Height.*	
	h.	'	*f.*	*inch.*
Ebbing	1	0	1	6
	2	0	2	6
	3	0	4	0
	4	0	4	0
	5	0	2	6
	6	0	1	6

The uſual Number of Tides, or Times of high Water from new Moon to new Moon, or from full Moon to full Moon, is 59.

In Hong-road, 4 *Miles from* Briſtol, by Capt. Sam. Sturmy, n. 14. p. 813.

5. (1.) I have obſerved, that our Annual Spring Tides do happen in *March* and *September*, either at the Tide next before the *Sun's* Ingreſs into the *equinoctial* Points of *Aries* and *Libra*, or the next Tide after, according as the Moon is near her Full or Change, when the Sun thus enters into the ſaid Signs; and when it flows in Height about 45 Foot; the loweſt Neap Tides flowing in Height 25 Foot.

Signs.

(2.) That the loweſt Neap makes the higheſt Spring, if the *N. E.* Winds hinder not, by blowing hard, and ſo keep back the Tides; as uſually they do when they blow: Whoſe contrary Winds, *S. W.* if they blow hard, make here the higheſt Tides.

(3.) That from about the latter End of *September* they are about 1 Foot and 3 Inches higher, perpendicularly, in the Evening than in the Morning; that is, if high Water happen after the Sun is paſt the *Meridian*, or in the Tides betwixt Noon and Midnight. But from *Michaelmas* to our *Lady-Day* we find the contrary, the Day-Tides being, in that Seaſon, higher by 15 Inches than the Night-Tides, or the Tides between Mid-night and Noon. And this Proportion holds in both, after the gradual Increaſe of the Tides riſing from the Neap to the higheſt Spring, and the like Decreaſe of their Height till Neap again.

(4.) That the higheſt menſtrual Spring-Tide is always the Third after the full Moon or Change-Day, if it be not kept back by *N. E.* Winds.

(5.) That it *flows* here on the Change-Day, when the Moon is *E. S. E.* the Tide flowing in for the Space of 5 Hours, and ebbing 7 Hours. But in Neap-Tides it does not flow here by two Points of the Compaſs ſo long.

(6.) That the Water flows nor ebbs equal Spaces in equal Times, but its Velocity is ſtronger at the firſt, both the Flood and Ebb, and ſo gradually decreaſeth untill full Sea, or low Water. This is obſerved in the Spring-Tides only, as you may ſee by the following Table, which I have made for my Obſervations of our Tides here. And I have farther obſerved, that it hath flowed and ebbed at the firſt of the Tide one Foot in 6 Minutes, or that then the Tide ran out a Foot in 6 Minutes, or did riſe ſo much in Height.

	Time.		*Height.*	
	h	'	*f.*	*inch.*
	0	15	2	7½
	0	30	2	6
	0	45	2	6
	1	00	2	6
	0	15	2	6
	0	30	2	5½
	0	45	2	5
	2	00	2	5
	0	15	2	3
Flowing	0	30	2	3
	0	45	2	3
	3	00	2	3
	0	15	2	2
	0	30	2	1
	0	45	2	1
	4	00	2	1
	0	15	1	9
	0	30	1	8
	0	45	1	8
	5	00	1	8
	5	0	44	1

	Time.		*Height.*	
	h	'	*f.*	*inch.*
	0	15	2	7½
	0	30	2	6
	0	45	2	6
	1	00	2	6
Ebbing.	2	00	9	0
	3	00	8	0
	4	00	6	0
	5	00	5	0
	6	00	4	0
	7	00	3	0
	7	0	44	10½

(7.) The uſual Number of Tides from New Moon to New Moon, or from Full to Full, is 59.

(8.) In the River of *Severn*, 20 Miles above *Briſtol* near *Newnham*, 160 Miles from the River's Mouth (*Lundy*) the *Head* of the Flood at its coming in in Spring-Tides ariſeth in Height, like a Wall, 9 Foot high, and ſo runs for many Miles together, covering at once all the Shoals which were dry before; at which time all *Veſſels*, that lie in the Way of the ſaid *Head-Tides*, or (as it is vulgarly called) *Boar*, are commonly overſet, or carried upon the *Banks*; and the *Head* of the *Tide* being paſt, ſuch *Veſſels* are left dry again. It flows there but two *Hours* and 18 *Foot* in Height, and it ebbs ten *Hours*. The Reaſon of the ſaid *Boar* is doubtleſs the ſtraitning and ſhoaling of the River in that Place, it being there but half a Mile broad; as it is but 20 Pearches over, three Miles higher; running tapering to *Glouceſter*.

(6.) We have been informed by a curious Gentleman, that the *Annual higheſt Tides* about *Chepſtow* Bridge were at St. *David*'s and *Michaelmas* Stream; that is, the one a little before the *Vernal*, and the other ſomewhat after the *Autumnal Æquinox*; which agrees alſo with the Conjecture of a very intelligent *Mathematician*, who is withal of Opinion, that becauſe both are not far from the *Æquinoxes*, tho' the one before, the other after, it might well give occaſion to think it was depending on the *Æquinox*.

At Chepſtow, by * * ibid. p. 826.

(7.) Our great *Bay* Mr. *Camden* calls *Waſhes*, whereas they are only two ſmall Arms of the Sea, running into it, *viz.* *Foſdike* and *Croſs-Keys*; 'tis full of Sands, making two Channels to *Lynn*, and as many to *Boſton*. It may be uſeful to Travellers to have a Table when to paſs over the ſaid *Waſhes*, tho' without a Guide I would not adviſe them, eſpecially after great Freſhes, which make the Sands ſhift, and conſequently quick, and Horſes many times ſtick faſt: The way to get them out is by ſeveral Peoples trampling round them at a Diſtance, which by Degrees raiſeth them.

A Table of the Waſhes *in* Lincolnſhire, by *Mr.* Chr. Merrit. n.223.p.352 n.224.p.392

Moon's Age.		*Foſdike begins.*		*Ends.*		*Full Sea.*		*Moon's Age.*		*Foſdike begins.*		*Ends.*		*Full Sea.*	
		h.	'	*h.*	'	*h.*	'								
1	16	10	0	4	45	7	0	9	24	4	24	11	9	1	24
2	17	10	48	5	33	7	48	10	25	5	12	11	57	2	12
3	18	11	36	6	21	8	36	11	26	6	0	12	45	3	00
4	19	12	24	7	9	9	24	12	27	6	48	1	33	3	48
5	20	1	12	7	57	10	12	13	28	7	36	2	21	4	36
6	21	2	0	8	45	11	0	14	29	8	24	3	9	5	24
7	22	2	48	9	33	11	48	15	30	9	12	3	57	6	12
8	23	3	36	13	21	12	36								

Croſs-Keys begins to be fordable fifteen Minutes after *Foſdike*, and ends an Hour ſooner.

(8.) It is high Water upon the Day of the *New* and *Full Moon*.

The Tides in France, by * * * * n.185.p.220

On the Coaſt of *Gaſcony* and *Guienne*.

At 3 *h.* at the Mouth of *Garonne*, and *the Iſle of Rhee*.

At 3 ½ *h.* at *St. John de Luz*, *Bayonne*, and *Memiſſan*.

At 3 ¼ *h.* at *Rohan*, *Brouage*, and *Rochelle*.

At 3 *h.* on the Coaſt of *Poitou*.

At 3 ¼ at *Ollonne* and *Beauvoir*.

On the Coaſt of *Britany*.

At 1 ½ *h.* at *Bell-Iſle*.

At 3 *h.* at the Mouth of the *Loyre*, at *Garande*, *Morbihan*, *Blavet*, and *Concarneau*.

At ¾ *h.* at *Apenars*, *Vannes*, and *Auray*.
At 2¼ *h.* at *Apenmark*, *Audierne*, the Race of *Fontenay*, and *Le Conquet*.
At 2¾ *h.* at *Breſt*, and at Cape de *Four*.
At 4 *h.* at St. *Paul de Leon*.
At 4½ *h.* at *Port Blanc*.
At 6 *h.* at St. *Malo* and *Cancale*.

On the Coaſt of *Normandy*.

At 7 *h.* at *Granville*, and *Barneville*.
At 8 *h.* at *Cherbourg* and *Barfleur*.
At 9 *h.* at *Caen* and *Honfleur*, at the Mouth of the *Seine*, and at *Havre de Grace*.
At 9¼ *h.* at *Feſcan*, and St. *Valeri*.
At 10½ *h.* at *Rouen*, *Dieppe*, and *Treport*.

On the Coaſt of *Picardie*:

At 11 *h.* at the Mouth of the *Somme*, at *Eſtaple*, *Bologne*, and *Ambleteuſe*.
At 11 *h.* at *Calais*.
At 12 *h.* at *Dunkirk*, *Newport* and *Oſtend*.

At Bermudas, *by Mr.* Rich. Norwood, n.30. p.565.

9. (1.) I have only taken a general notice of the *Tides*, as that it is high Water about 7 of the Clock on the *Change-Day* (in ſome *Creeks* an Hour or two later.) The *Water* riſeth but little, as about 4 Foot at *high Water*, but at *Spring-Tides* it may be a Foot more. The *Tides* without are very various in *Setting*: Sometimes the Tide of Flood ſets to the Eaſtward, ſometimes to the Weſtward; but in fair, calm, and ſettled Weather, the ſaid Tide ſets from the South-Eaſt toward the North-Weſt, as they ſay.

By Mr. Rich. Stafford, n. 40. p. 792.

(2.) The Water about our Iſland (*Bermudas*) does not flow, by any Man's Obſervation, above 5 Foot; and that but at one Seaſon of the Year, between *Michaelmas* and *Chriſtmas*; at other times not above 3 Foot. It is high Water when the Moon is about an Hour high, and the like after her going down. It flows in from the *North-Weſt*, and runs to the *South-Eaſt* neareſt; and in that Part of the Land, which lies moſt to the *North-Weſt*, there it is high Water ſooneſt. But the Tide does not always ebb and flow directly that Courſe round about our Coaſt; but, I ſuppoſe, the Reaſon is, that ſome Points of Land or Shoals may turn its *North-Weſt* and *South-Eaſt* Courſe.

At Cabo Cors *Caſtle on the Coaſt of* Guinea, *by Mr.* Heathcot. n.158. p.578

10. The Sea runs here along the Shore continually to the *Eaſtward*, at a very great Rate, except at Full and Change; for then it runs to *Weſtward*, or at leaſt makes a great Abate. *Nov.* 24. 1683. I took the time of the high Water at the *Caſtle* (as near as I could) at 3 *h.* 30. *p. m.* it flowed about 6 Foot.

An Hypotheſis *about the* Flux *and* Reflux *of Sea by Dr.* Wallace. n.16. p.235.

V. (1.) The *Sea's ebbing* and *flowing* hath ſo great a Connection with the Moon's Motion, that in a manner all *Philoſophers* (whatever other Cauſes they have joined with it) have attributed much of its Cauſe to the *Moon*; which either by ſome *occult Quality*, or particular Influence which it hath on moiſt Bodies, or by ſome *magnetick Virtue*, drawing the Water towards it (which ſhould therefore make the Water there higheſt, where the *Moon* is vertical) or by its Gravity and Preſſure downwards upon the terraqueous Globe (which ſhould make it loweſt where the *Moon* is vertical) or by whatever other Means (according to the ſeveral Conjectures of inquiſitive Perſons) hath ſo great an Influence on, or at leaſt a Connection with the *Sea's Flux* and *Reflux*, that it would ſeem very unreaſonable to ſeclude the Conſideration of the Moon's Motion from that of the *Sea*: The *Periods* of *Tides* (to ſay nothing of the Greatneſs of them near the *new Moon*, and *full Moon*) ſo conſtantly waiting on the Moon's Motion, that it may be well preſumed, that either the one is governed by the other, or at leaſt both from ſome common Cauſe.

The firſt that I know of, who took in the Conſideration of the Earth's Motion (*Diurnal* and *Annual*) was *Galilæo*; who, in his *Syſtem of the World*, hath a particular and very rational Diſcourſe on this Subject. But that Diſcourſe is to be look'd upon only as an Eſſay of the general Hypotheſis; which, as to Particulars, was to be afterwards adjuſted from a good *general Hiſtory of Tides*; which 'tis manifeſt enough that he had not; and which is yet in a great Meaſure wanting.

And what I ſay of *Galilæo* I muſt in like Manner deſire to be underſtood of what I am now ready to ſay to you. For I do not profeſs to be ſo well skill'd in the *Hiſtory* of *Tides*, as that I will undertake preſently to accommodate my general Hypotheſis to the particular Caſes; or that I will indeed undertake for the certainty of it, but only as an Eſſay propoſe it to farther Conſideration, to ſtand or fall, as it ſhall be found to anſwer Matter of Fact.

I conſider therefore that in the *Tides*, or the *Flux* or *Reflux* of the Sea, beſides extraordinary Extravagancies, or Irregularities, whence great Inundations or ſtrangely High-Tides do follow, which yet perhaps may prove not to be ſo merely accidental as they have been thought to be, but might from the regular Laws of Motion, if well conſider'd, be both well accounted for, and even foretold; there are theſe three notorious Obſervations made of the *Reciprocation* of Tides. *Firſt*, The *Diurnal Reciprocation*, whereby twice in ſomewhat more than 24 Hours we have a Flood and an Ebb; or a High-Water and Low-Water. *Secondly*, The *Menſtrual*; whereby in one *ſynodical Period* of the Moon, ſuppoſe from *full Moon* to *full Moon*, the Time of thoſe *diurnal Viciſſitudes* doth move round thro' the whole Compaſs of the Νυχθήμερον, or natural Day of 24 Hours: As for Inſtance, if at the *full Moon*, the *full Sea* be at ſuch or ſuch a Place juſt at Noon, it ſhall be the next Day, at the ſame Place, ſomewhat before one of the Clock; the Day following, between one and two; and ſo onward, till at the new Moon it ſhall be at Mid-night; (the other Tide, which in the *full Moon* was at *Mid-night*, now in the *new-Moon* coming to be at Noon) and ſo forward, till at the next full Moon the full Sea ſhall at the ſame Place come to be at Noon again. Again, that of the Spring Tides and Neap Tides, as they are called, about the full Moon and new Moon the Tides are at the higheſt; at the *Quadratures* the Tides are at the loweſt: And at the Times intermediate proportionably. *Thirdly*, the *Annual*; whereby it is obſerved, that at ſome times of the Year the *Spring-Tides* are yet much higher than the *Spring-Tides* at other times of the Year; which times are uſually taken to be at the *Spring* and *Autumn*, or two *Æquinoxes*; but I have Reaſon to believe, (as well from my own Obſervations for many Years, as of others, who have been much concerned to heed it, whereof more will be ſaid by and by) that we ſhould rather aſſign the beginning of *February* and *November*, than the two *Æquinoxes*.

1. Now, in order to give an Account of theſe three Periods according to the Laws of Motion and Mechanick Principles, we ſhall firſt take it for granted, what is now a-Days pretty commonly entertained by thoſe who treat of ſuch Matters that a Body in *Motion* is apt to continue in its *Motion*, and that in the ſame Degrees of *Celerity*, unleſs hindered by ſome contrary *Impediment*: Like as a Body at Reſt to continue ſo, unleſs by ſome ſufficient Mover put into Motion: And accordingly, which daily Experience teſtifies, if on a Board or Table ſome looſe incumbent Weight be for ſome time *moved*, and have thereby contracted an *Impetus* to *Motion* at ſuch a *Rate*, if that Board or Table chance by ſome external Obſtacle, or otherwiſe, to be ſtopped, or conſiderably retarded in its Motion, the incumbent looſe Body will ſhoot forward upon it; and contrariwiſe, in caſe that Board or Table chance to be accelerated, or put forward with a conſiderably greater Speed than before, the looſe incumbent Body, not having yet obtained an equal *Impetus* with it, will be left behind, or ſeem to fly backward upon it. Or, which is *Galileo*'s Inſtance, if a broad Veſſel of Water, for ſome time evenly carried forward with Water in it, chance to meet with a Stop, or ſlack its Motion, the Water will daſh forward and riſe higher at the fore part of the Veſſel; and contrariwiſe, if the Veſſel be ſuddenly put forward faſter than before, the Water will daſh backwards, and riſe at the hinder part of the Veſſel. So that an Acceleration or *Retardation* of the Veſſel, which carries it, will cauſe a riſing of the Water in one Part, and a falling in another; which yet, by its own Weight, will again be reduced to a Level as before. And conſequently, ſuppoſing the *Sea* to be but as a looſe Body carried about with the Earth, but not ſo united to it as neceſſarily to receive the ſame Degree of *Impetus* with it, as its fixed Parts do, the *Acceleration* or *Retardation* in the Motion of this or that Part of the Earth will cauſe, more or leſs, according to the Proportion of it, ſuch a *daſhing* of the Water, or *riſing* at one Part, with a *falling* at another, as is that which we call the Flux and Reflux of the Sea.

Now, this premiſed, we are next with him to ſuppoſe the Earth carried about with a double Motion, the one *Annual* in *BEC*, the great Orb, in which the Center of the Earth *B* is ſuppoſed to move about the Sun *A*; the other Diurnal, whereby the whole moves upon its own *Axis*, and each in its Surface deſcribes a Circle, as *D E F G*.

It is then manifeſt, that if we ſuppoſe that the *Earth* moved but by any one of theſe *Motions*, and that regularly with an equal *Swiftneſs*, the *Water*, having once attained an equal *Impetus* thereunto, would ſtill hold equal Pace with it, there being no occaſion, from the quick'ning or ſlack'ning of the *Earth*'s *Motion*, in that Part where the *Water* lieth, for the *Water* thereon either to be caſt forward or backward, and thereby to *accumulate* on the other Parts of the *Water:* But the true Motion of each Part of the Earth's Surface being compounded of thoſe two *Motions*, the *Annual* and *Diurnal*; (the *Annual* in *BEC* being, as *Galileo* there ſuppoſeth, about three Times as faſt as a *diurnal Motion*, in a great Circle, as *DEF*) while a Point of the *Earth*'s Surface moves about its Center *B* from *G* to *D* and *E*, and at the ſame time its Center *B* be carried forwards to *C*; the true *Motion* of that Point afterwards is made up of both thoſe *Motions*; to wit, of *B* to *C*, and of *G* to *E*; but while *G* moves by *D* to *E*, *E* moves backward by *F* to *G*, contrary to the Motion of *B* to *C*; ſo that the true Motion of *E* is but the Difference of *BC* and *EG*. (For, beſides the Motion of *B* above the Center, *G* is alſo put forward as much as from *G* to *E*, and *E* put backward as much as from *E* to *G*.) So that the *Diurnal Motion*, in that Part of the *Earth* which is next the *Sun*, as *EFG*, doth abate the Progreſs of the *Annual*, and moſt of all at *F*; and in the other Part which is from the *Sun*, as *GDE*, it doth increaſe it, and moſt of all at *D*; that is, in the *Day* Time there is abated, in the *Night*-Time is added, to the *Annual* Motion, about as much as is *GE*, the *Earth*'s Diameter. Which would afford us a Cauſe of two *Tides* in 24 *Hours*; the one upon the greateſt *Acceleration* of *Motion*; the other upon its greateſt *Retardation*.

(2.) And thus far *Galileo*'s Diſcourſe holds well enough; but then in this it comes ſhort; that as it gives an Account of *two Tides*, ſo thoſe *two Tides* are always to be at *F* and *D*; that is, at *Noon* and at *Midnight:* Whereas Experience tells us, that the time of *Tides* moves in a Month's Space through all the 24 Hours; of which he gives us no Account. For tho' he doth take notice of a *menſtrual Period*; yet he doth it only as to the Quantity of the *Tides*, greater or leſs; not as to the Time of the *Tide*, ſooner or later.

To help this *J. Bapt. Balianus* makes the *Earth* to be but a *ſecondary* Planet, and to move not directly about the *Sun*, but about the *Moon*; the *Moon* mean while moving about the *Sun*, in like Manner as we ſuppoſe the *Earth* to move about the *Sun*, and the *Moon* about it. But though this might furniſh us with the Foundation of a *menſtrual Period* of *Accelerations* and *Retardations* in the compound Motion of ſeveral Parts of the *Earth*'s Surface, yet there are no good Reaſons to admit of this *Hypotheſis*.

Ricciol. *Alm. Nov. Tom.* 1. l. 4. 2. 10. n. 111. p. 236. 2.

Inſtead of this, that *Surmiſe* of mine (for I dare not yet, with Confidence, give it any better Name) of what I have ſpoken to you heretofore (and which hath occaſioned this preſent Account which I am now giving you) is to this Purpoſe.

The *Earth* and *Moon* being known to be Bodies of ſo great Connection, as that the *Motion* of *One* follows that of the *Other*, may well enough be looked upon as one Body, or rather one Aggregate of Bodies, which have one common Center of Gravity; which Center of Gravity, according to the known Laws of *Staticks*, is in a ſtrait Line connecting their reſpective Centers ſo divided, as that its Parts be in reciprocal Proportion to the Gravities of the two Bodies. As for Example, ſuppoſe the *Magnitude* (and therefore, probably, the Gravity) of the *Moon* to be about a *one and fortieth* Part of that of the *Earth*; and the Diſtance of the *Moon*'s Center from the Center of the *Earth* to be about 56 *Semidiameters* of the *Earth*, the Diſtance of the common Center of Gravity of the two Bodies will be from that of the *Earth* about $\frac{1}{42}$ of 56 *Semidiameters*, that is about $\frac{1}{3}$ of a *Semidiameter* of the *Earth*, above its Surface, in the Air, directly between the *Earth* and *Moon*.

Now ſuppoſing the *Earth* and *Moon* jointly, as one Body, carried about by the *Sun* in the *great Orb* of the *Annual* Motion; this Motion is to be eſtimated (according to the Laws of *Staticks* in other Caſes) by the Motion of the common Center of Gravity of both Bodies. For we uſe in *Staticks* to eſtimate a Body, or Aggregate of Bodies, to be moved upwards, downwards, or otherwiſe, ſo much as its common Center of Gravity is ſo moved, howſoever the Parts may change Places amongſt themſelves.

And accordingly the Line of the *Annual* Motion will be deſcribed, not by the Center of the *Earth* (as we commonly eſtimate it) but by the common Center of Gravity of the Bodies, *Earth* and *Moon*, as one Aggregate.

Fig. 52. Now ſuppoſing *A B C D E* to be a Part of the *great Orb* of *Annual Motion*, deſcribed by the common Center of Gravity, in ſo long time as from a *full Moon* at *A* to the next *new Moon* at *E*; the Center of the Earth at *T*, and that of the *Moon* at *L*, muſt each of them, (ſuppoſing their *common Center* of *Gravity* to keep the Line *AE*) be ſuppoſed to deſcribe a Periphery about that *common Center*, as the *Moon* deſcribes her Line of *menſtrual Motion*. And in like Manner, *EFGHI*, from the *new Moon* at *E* to the next *full Moon* at *I*;

Fig. 53. From *A* to *E* (from full Moon to new Moon) *T* moves (in its own *Epicycle*) upwards from the Sun: And from *E* to *I* (from new Moon to full Moon) it moves downwards, towards the Sun. Again, from *C* to *G* (from laſt Quarter to the following firſt Quarter) it moves forward according to the *Annual* Motion; but from *G* forwards to *C* (from the firſt Quarter to the enſuing *laſt Quarter*) it moves contrary to the *Annual* Motion.

It is manifeſt therefore, according to this *Hypotheſis*, that from the laſt Quarter to the firſt Quarter (from *C* to *G*, while *T* is above the Line of the *Annual* Motion) its *menſtrual* Motion in its *Epicycle* adds ſomewhat of *Acceleration* to the *Annual* Motion; and moſt of all at *E*, the new Moon: And from the firſt to the laſt Quarter (from *G* forward to *C*, while *T* is below the Line of the *Annual* Motion) it abates of the *Annual* Motion; and moſt of all at *I*, or *A*, the full Moon.

So that in Purſuance of *Galileo*'s Notion the *menſtrual* adding to, or detracting from the *Annual* Motion, ſhould either leave behind, or caſt forward the looſe Waters incumbent on the *Earth*, and thereby cauſe a *Tide*, (or Accumulation of Waters) and moſt of all at the full Moon and new Moon, where thoſe *Accelerations* or *Retardations* are greateſt.

Now this *menſtrual* Motion, if nothing elſe were ſuperadded to the *Annual*, would give us two *Tides* in a Month, and no more; (the one upon the *Acceleration*, and the other on the *Retardation*) at new Moon and full Moon; and two Ebbs at the two Quarters; and in the Intervals, riſing and falling Water.

But the *Diurnal* Motion ſuperadded, doth the ſame to this *Menſtrual*, which *Galileo* ſuppoſeth it to do to the *Annual*; that is, doth add to, or ſubſtract from the *menſtrual Acceleration* or *Retardation*; and ſo gives us *Tide* upon *Tide*.

For in whatſoever part of its *Epicycle* we ſuppoſe T to be; yet becauſe, while by its *menſtrual* Motion the Center moves in the Circle LTN, each Point in its Surface, by its diurnal Motion, moves in the Circle LMN; whatſoever Effect (accelerative or retardative) the *Menſtrual* would give, that Effect, by the Diurnal, is encreaſed in the Parts LMN (or rather lMn, the Semicircle) and moſt of all at M; but diminiſhed in the Parts NOL (or rather nOl) and moſt of all at O. So that M and O (that is, when the Moon is in the *Meridian* below or above the *Horizon*) we are to have the *diurnal Tide* or *High-Water*, occaſioned by the greateſt *Acceleration* or *Retardation* which the *Diurnal Arch* gives to that of the *Menſtrual*; which ſeems to be the true Cauſe of the *daily Tides*, and withal gives an Account, not only why it ſhould be every Day, but likewiſe why at ſuch a Time of the Day; and why this time ſhould in a Month run through the whole 24 Hours, *viz.* becauſe the Moon's coming to the *Meridian* above and below the Horizon (or as the Seamen call it, the Moon's *Southing* and *Northing*) doth ſo; and likewiſe of the *Spring-Tides*, and *Neap-Tides*. For, when it ſo happens that the *menſtrual* and *diurnal Accelerations* or *Retardations* be co-incident (as at the New Moons and Full Moons they are) the Effect muſt needs be the greater. And although (which is not to be diſſembled) this happen but to one of the two *Tides*; that is, the *Night-Tide* at the New Moon (when both Motions do moſt of all *accelerate*) and the *Day-Tide* at Full Moon (when both do moſt retard the *annual* Motion;) yet, this *Tide* being thus raiſed by two concurrent Cauſes, tho' the next *Tide* have not the ſame Cauſe alſo, the *Impetus* contracted will have Influence upon the next *Tide*; upon a like Reaſon as a *Pendulum*, let fall from a higher *Arch*, will (tho' there be no new Cauſe to occaſion it) make the Vibration on the other Side (beyond the Perpendicular) to be alſo greater: Or, of Water in a broad Veſſel, if it be ſo jogged as to be caſt forward to a good height above its Level, will, upon its Recoiling, by its own Gravity (without any additional Cauſe) mount ſo much the higher on the hinder Part. Fig. 54.

But here alſo we are to take notice, that though all Parts of the Earth, by its *diurnal* Motion, do turn about its Axis, and deſcribe parallel Circles, yet not equal Circles; but greater near the *Æquinoctial*, and leſſer near the Poles; which may be a Cauſe why the *Tides* in ſome Parts may be much greater than in others. But this belongs to the particular Conſiderations, (of which we are not now giving an Account) not to the general *Hypotheſis*.

3dly, The *annual High Tides* having been obſerved (groſly) to happen about the *Spring* and *Autumn*, they are generally referred to the two *Æquinoxes*. But the Inhabitants of *Romney-Marſh* in *Kent*, where the Sea being kept out with great Earthen Walls, that it doth not at *High-Water* overflow the Level, are generally agreed by their Obſervations (and Experience dearly bought) that their Times of Danger are about the Beginning of *February* and of *November*; that is, at thoſe *Spring-Tides* which happen near thoſe Times; to which they give the Names of *Candlemas-Stream*, and *Allhallond-Stream*: And, if they eſcape thoſe *Spring-Tides*, they apprehend themſelves out of Danger for the reſt of the Year. And as for *March* and *September* (the two *Æquinoxes*) they are as little ſolicitous of them as of any other Part of the Year. And I have my ſelf very frequently obſerved (both at *London*, and elſewhere) that in thoſe Months of *February* and *November* (eſpecially *November*) the Tides have run much higher than at other times; particularly in *November* 1660. I found the Water ſo high in *King-ſtreet*, *Weſtminſter*, that it came up not only into the Boots, but into the Body of the Coach, and the *Palace-Yard* (all ſave a little Place near the Weſt-End) overflowed; as likewiſe the Market-Place, and many other Places, and their Cellars generally filled up with Water. And in *November* 1665 it may be well remembered what very High-Tides there were, not only on the Coaſts of *England* (where much Hurt was done by it) but much more in *Holland*, where, by reaſon of thoſe Inundations, many Villages and Towns were overflowed.

'Tis true, there does not happen any ſingle ſignal Accident, which might caſt it on theſe times, yet there is a Compound of Two that may do it: Which is the *Inequality* of the *natural Day* (well known to *Aſtronomers*) ariſing from a double Cauſe. *Firſt*, becauſe the Sun, by reaſon of its *Apogæum* and *Perigæum*, doth not at all times of the Year diſpatch, in one Day, an equal Arch of the *Ecliptick*: *Secondly*, Equal Arches of the *Ecliptick* do not in all Parts of the *Zodiack* anſwer to equal Arches of the *Æquinoctial*, by which we are to eſtimate Time.

According to the firſt of theſe Cauſes we ſhould have the longeſt Natural Days in *December*, and the ſhorteſt in *June*; which, if it did operate alone, would give us at thoſe times two *annual High-Waters*. According to the ſecond Cauſe, if operating ſingly, we ſhould have the longeſt Days in the two *Solſtices* in *June* and *December*, and the two ſhorteſt at the *Æquinoxes*, in *March* and *September*; which would at thoſe times give occaſion of four *annual High-Waters*.

But the true Inequality of the natural Days ariſes from a Complication of thoſe two Cauſes, ſometimes croſſing, and ſometimes promoting each other; though we ſhould find ſome Increaſes or Decreaſes of the natural Days at all thoſe Seaſons, anſwerable to the reſpective Cauſes, (and perhaps of *Tides*) proportionably thereunto: Yet the longeſt and ſhorteſt natural Days abſolutely of the whole Year (ariſing from this Complication of Cauſes) are about thoſe times of *Allhallontide* and *Candlemas*, or not far from them, about which thoſe *annual High-Tides* are found to be; as will appear by the *Tables of Æquation* of *natural Days*. And therefore, I think, we may with very good Reaſon caſt this *annual Period* upon that Cauſe, or rather Complication of Cauſes. For (as we before ſhewed in the *menſtrual* and *diurnal*) there will, by this Inequality of natural Days, ariſe a phyſical *Acceleration* and *Retardation* of the *Earth*'s mean Motion, and accordingly a caſting of the Waters backward or forward; either of which will cauſe an Accumulation or High-Water.

I muſt here add, (that I be not miſtaken) that whereas I caſt the time of the *daily Tides* to be at all Places when the Moon is there in the Meridian;

it muſt be underſtood of *open Seas*, where the Water hath ſuch free Scope for its Motion, as if the whole Globe of Earth were equally covered with Water: Well knowing, that in *Bays* and *Inland Channels* the Poſition of the Banks, and other like Cauſes, muſt needs make the Times to be much different from what we ſuppoſe in the *open Seas:* And likewiſe, that even in the *open Seas*, *Iſlands*, and *Currents*, *Gulfs* and *Shallows* may have ſome Influence, though not comparable to that of the *Bays* and *Channels*. And moreover, though I think that Seamen do commonly reckon the time of *High-Water* in the open Seas to be then, when the Moon is there in the Meridian (as this *Hypotheſis* would caſt it;) yet I do not take my ſelf to be ſo well furniſhed with a Hiſtory of *Tides*, as to aſſure myſelf of it; much leſs to accommodate it to particular Places and Caſes.

It may be thought perhaps, that if the Earth would thus deſcribe an *Epicycle* about the common Center of Gravity, it would (by this its Change of Place) diſturb the cœleſtial Motions, and make the apparent Places of the Planets, eſpecially ſome of them, different from what they would otherwiſe be. For though ſo ſmall a Removal of the Earth, as the *Epicycle* would cauſe (eſpecially if its Semi-Diameter ſhould not be above 1½ of the Earth's Semi-Diameter) would ſcarce be ſenſible, if at all, to the remoter Planets; yet, as to the nearer, it might.

To this my Anſwer is, that ſuch Difference hath been obſerved, and hath very much puzzled *Aſtronomers* to give an Account of. Mr. *Horrocks* was forced to have recourſe to ſomewhat like *Kepler's amicable Fibres* (which he had no Affection to at all) to give Account of the Inequalities of the Moon's Motion. And other *Aſtronomers* have introduced (ſome upon one Suppoſition, ſome upon another) ſome kind of *menſtrual Æquation*, to ſolve the Inequalities of the Moon's Motion, according to her *Synodical* Revolution, or different Aſpects (of New Moon, Full Moon, *&c.*) beſides what concerns her own periodical Motion. For which, this Conſideration of the common Center of Gravity of the Earth and Moon is ſo proper a Remedy (eſpecially if it ſhould be found preciſely to anſwer thoſe *Phænomena*, which I have not examined, but am very apt to believe) that it is ſo far from being, with me, an Objection againſt it, that it is one of the Reaſons which make me inclinable to introduce it.

The like Conſideration may reaſonably be had of *Jupiter* and *Saturn*, and their *Satellites*, which yet, becauſe of their Smallneſs, may chance to be ſo little, as that at this Diſtance the Change of their apparent Places may not be diſcernable. For all theſe *Satellites* are to their Principals as ſo many Moons to the Earth. And Mr. *Horrocks* expreſſeth ſome ſuch little Inequalities in *Saturn*'s Motion, of which he could not imagine what Account to give: Which, for ought I know, might have been accounted for, if at that time the *Satellites* of *Saturn* had been diſcovered, and that Mr. *Horrocks* had thought of ſuch a Notion as the common Center of Gravity of *Saturn* and his Companions to be conſiderable, as to the guiding of his *Motion*.

2. 1ſt, To the firſt Objection, *That it appears not how two Bodies, that have a Tye, can have no common Center of Gravity:* that is (for ſo I underſtand the Intendment of the Objection) can act or be acted in the ſame manner, as if

Some Objections anſwered; by Dr. Wallis ibid. p. 281.

if they were connected; I ſhall only anſwer, that it is harder to ſhew how they have, than that they have. That the Loadſtone and Iron have ſomewhat equivalent to a Tye, though we ſee it not, yet by the Effects we know. And it would be eaſy to ſhew, that two Load-Stones, at once applied in different Poſitions to the ſame Needle, at ſome convenient Diſtance, will draw it not to point directly to either of them, but to ſome Point between both; which Point is, as to thoſe two, the common Center of *Attraction*; and it is the ſame as if ſome one Load-Stone were in that Point. Yet have theſe two Load-Stones no Connection or Tye, though a common Center of Virtue, according to which they jointly act. And that there is ſomewhat that doth connect the Earth and Moon (as much as what connects the Load-Stone and the Iron which it draws) is paſt doubt to thoſe who allow them to be carried about by the Sun, as one Aggregate or Body, whoſe Parts keep a reſpective Poſition to one another: Like as *Jupiter* with his four *Satellites*, and *Saturn* with his one.

To the Second Objection; *That at* Chatham *and in the* Thames *the annual Spring-Tides happen about the* Æquinoxes; *not* (*as this Hypotheſis doth ſuppoſe elſewhere to have been obſerved*) *about the Beginning of* February *and* November. If their Meaning be, that *annual High-Tides* do then happen, and then only; if this prove true, it will eaſe me of half my Work: For it is then eaſily anſwered, that it depends upon the *Obliquity* of the *Zodiack*; the Parts of the *Æquinoctial*, anſwering to equal Parts of the *Zodiack*, being near the *Solſtitial* Points greateſt, and near the *Æquinoctial* Points leaſt of all. But beſides this *annual* Viciſſitude of the *Æquinoxes*, not to ſay of the Four *Cardinal Points* (which my *Hypotheſis* doth allow and aſſert) I believe it will be found, that there is another *annual* Viciſſitude anſwering to the *Sun's Apogæum* and *Perigæum*; and that the greateſt Tides of all will be found to be upon a Reſult of theſe two Cauſes co-operating. And to what is ſaid to be obſerved at *Chatham* and in the *Thames*, contrary to that I alledge, as is obſerved in *Romney-Marſh*; I muſt at preſent ἐπέχειν, and refer to a *melius inquirendum*: For a good Diary of the Height and Time both of High-Water and Low-Water, for a Year or two together, even at *Chatham* or *Greenwich*; but rather at ſome Place in the open Sea, or at the *Land's End* in *Cornwall*, or on the Weſt Parts of *Ireland*, or at St. *Helen's*, or the *Bermudas*, &c. would do more to the reſolving of this Point, than any verbal Diſcourſe without it.

3*dly*, To the third Objection, *That ſuppoſing the Earth and Moon to move about a common Center of Gravity*; *if that the higheſt Tides be at the* New Moon, *when, the* Moon *being neareſt to the* Sun, *the Earth is fartheſt from it, and its Compound Motion at the ſwifteſt*; *and that the Tides abate as the* Earth *approacheth nearer, 'till it comes into the ſuppoſed Circle of her* annual Motion; *it may be demanded, why do they not ſtill abate, as the* Earth *comes yet nearer to the* Sun; *and the Swiftneſs of its compound Motion ſtill ſlackens? And ſo, why have we not Spring-Tides at the* New Moon (*when the Motion is ſwifteſt*) *and Neap-Tides at* Full Moon (*when the Motion is ſloweſt*) *but Spring-Tides at both?* The Anſwer, if obſerved, is already given in my *Hypotheſis* it ſelf.

Becauſe the Effect is indifferently to follow, either upon a ſudden *Acceleration*, or a ſudden *Retardation*. Now both of theſe happening, the one at the New Moon, the other at the Full Moon, do cauſe high Tides at both.

4thly, To the 4th Objection, *That the* higheſt Tides *are not at all Places about the* New Moon *and* Full Moon, *and particularly that, in ſome Places of the* Eaſt-Indies, *the* higheſt Tides *are at the* Quadratures: I anſwer in general; That as to the particular *Varieties* of *Tides* in ſeveral Parts of the World I cannot pretend to give a ſatisfactory Account, for Want of a competent Hiſtory of *Tides*, *&c.* becauſe, as is intimated in what I wrote in the general, the various Poſitions of *Channels*, *Bays*, *Promontories*, *Gulphs*, *Shallows*, *Currents*, *Trade-Winds*, *&c.* muſt needs make an innumerable Variety of Accidents in particular Places, of which no ſatisfactory Account is to be given from the general *Hypotheſis*, though never ſo true, without a due Conſideration of all thoſe. Which is a Task too great for me to undertake, being ſo ill furniſhed with Materials for it.

5thly, To the 5th Objection, *That the Spring-Tides happen not with us juſt at the* Full *and* Change, *but two or three Days after*: I ſhould with the more Confidence attempt an Anſwer, were I certain whether it be ſo in the open Seas, or only in our *Channels*. For the Anſwers will not be the ſame in both Caſes. If only in our *Channels*, where the *Tides* find a large Indraught, but not in the open Seas, we muſt then ſeek a Reaſon of it from the particular Poſition of theſe Places: But if it be ſo generally in the wide open Seas, we muſt then ſeek a Reaſon of it from the general *Hypotheſis*: And, 'till I know the Matter of Fact, I know not well which to offer at. I know that Mariners uſe to ſpeak of *Spring-Tides* at the New and Full of the Moon; though I have ſtill had a Suſpicion that it might be ſome Days after, as well in the open Seas, as in our narrower *Channels*. And therefore I have choſen to ſay, in my Papers, *about* the New and the Full, rather than *at* the New and Full; and even when I do ſay At, I intend it in that laxer Senſe, in which I ſuppoſe the Mariners are to be underſtood, for Near that time. The Truth is, the Flux and Reflux of Water in a Veſſel by reaſon of the jogging of it, though it follow thereupon, yet is, for the moſt Part, diſcernable ſome time after. For there muſt, upon that Jog, be ſome time for Motion, before the Accumulation can have made a *Tide*. And ſo I do not know but that we muſt allow it in all the Periods: But in my conjectural *Hypotheſis*, while it is yet but a Candidate, I did not think myſelf obliged to ſpeak more nicely.

But now, after all, the cleareſt Evidence for this *Hypotheſis*, if it can be had, will be from *Cœleſtial Obſervations*. As for Inſtance; ſuppoſing the Fig. 55. Sun at *S*, the *Earth*'s Place in its *annual Orb* at *T*, and *Mars* (in Oppoſition to the *Sun* or near it) at *M*: From whence *Mars* ſhould appear in the *Zodiack* at *γ*, and will at Full Moon be ſeen there to be, the Moon being at *C*, and the *Earth* at *C*; and the like at the New Moon. But if the Moon be in the Firſt Quarter at *A*, and the Earth at *a*; *Mars* will be ſeen not at *γ*, but at *α*, too ſlow: And when the Moon is at *B*, and the Earth at *b*, *Mars* will be ſeen at β; yet too ſlow: Till at the Full Moon, the Moon at C, the *Earth* at *c*, *Mars* will be ſeen at γ, its true Place, as if the *Earth* were at Υ. But then after the Full, the Moon at *D*, the Earth at *d*, *Mars* will be ſeen, not at γ, but at δ; too forward, and yet more when the Moon, at the laſt Quarter, is at *E*, the Earth at *e*, and *Mars* ſeen at ϵ. If therefore *Mars*, when in *Oppoſition* to the *Sun*, be found, all other Allowance being made, ſomewhat too backward before the Full Moon, and ſomewhat too forward after the Full Moon, and moſt of all, at the Quadratures, it will be the beſt Confirmation of the *Hypotheſis*. The like may be fitted to *Mars* in other Poſitions, *mutatis mutandis*, and ſo for the other Planets.

But this Proof is of like Nature as that of the Parallaxis of the Earth's *annual Orb* to prove the Copernican Hypotheſis. If it can be obſerved it proves the Affirmative, but if it cannot be obſerved it proves the Negative; but only proves that the Semi-Diameter of the Earth's Epicycle is ſo ſmall as not to make any diſcernable Parallax. And indeed I doubt that will be the Iſſue. For the Semi-Diameter of this Epicycle being little more than the Semi-Diameter of the Earth itſelf, or about $1\frac{1}{2}$ thereof, as is conjectured in the Hypotheſis from the Magnitudes and Diſtances of the Earth and Moon compared; and there having not as yet been obſerved any diſcernable Parallax of *Mars*, even in his neareſt Poſition to the Earth, it is very ſuſpicious, that here it may prove ſo too.

The Variety *of the* Annual Tides, *in ſeveral Places of* England, *conſider'd, by Dr.* Wallis, n. 34. p. 652.

3dly, In my Hypotheſis for Tides I caſt the annual High-Tides for the Coaſt of *Kent*, and conſequently the Rivers of *Thames* and *Medway*, about the Beginning of *November* and *February*: Which agrees with Obſervations on thoſe Coaſts, and particularly with that of yours [Mr. *Oldenburgh*'s] of *Feb.* 5. $166\frac{7}{8}$.

The laſt Year [1667] when I was preſent in the *R. S.* I remember an Account was brought us of the *annual High-Tides* on the *Severn*, and at *Cheapſtow-Bridge*, to be about the Beginning of *March*, and the End of *September*: Which, though they agree not with the particular Times on the Coaſt of *Kent*, yet in the general they agree thus far, That the one is about as much before the one *Æquinox*, as the other is after the other *Æquinox*. You now acquaint me with the *High-Tides* about *February* 22. about the Coaſt of *Plymouth*, which is later than that of the Coaſt of *Kent*, but ſooner than that on the *Severn*. And I doubt not but that in other Parts of the World will be found other Varieties.

The Reaſons of theſe Varieties are, as I have formerly ſignified, to be attributed to the particular Poſition of thoſe Parts, rather than to the general Hypotheſis.

Of which this, in brief, may ſerve for ſome Account at preſent. The *General Hypotheſis* of the *Earth's diurnal* Motion from Weſt to Eaſt would caſt that of the *Waters*, not following ſo faſt from Eaſt to Weſt, which cauſeth the *conſtant Current* within the *Tropicks* where the Circles are greateſt, *Weſtward*, from the Coaſt of *Africa* to that of *America*; which is alſo the Cauſe of the conſtant *Eaſtern Breeze* blowing in thoſe Parts. But the Sea, thus beating on the Coaſt of *America*, is caſt back as with an *Eddy* on either Hand, and conſequently returns from the *American* Shore Eaſtward towards the Coaſt of *Europe*, where the parallel Circles to the *Æquator* being leſs, and conſequently the *diurnal Motion* ſlower, doth not caſt the Water ſo ſtrongly Weſtwards as between the *Tropicks*, and ſo not ſtrong enough to overcome the *Eddy* which it meets with from the other Motion, which gives the Sea a North-eaſterly Motion on theſe Coaſts, as to its uſual Courſe. The *Current* therefore of our Seas being North-eaſterly, we are next to conſider, at what time it runs more to the North, and at what more to the Eaſt. When it runs moſt Northerly, it runs up the *Iriſh-Sea*, and ſo up the *Severn:* When moſt Eaſterly, it runs ſtraight up the *Channel*, and ſo to the Coaſt of *Kent:* When between theſe, it beats againſt *Devonſhire* and *Cornwall*, and thoſe Parts. We are therefore to conſider, as to the annual Periods, that the annual Motion of the Earth in the *Zodiack*, and the *Diurnal* in the *Æquator*, are not preciſely in the ſame Direction, but make an *Angle* of 23 ½ *Deg.* at the *Æquinoxes*, but run, as it were, parallel at the *Solſtices*; and as they be nearer or farther from theſe Points, ſo is the Inclination varied; which ſeveral Directions of Motion do cauſe the compound Motion of both to vary from the Eaſt and Weſt more or leſs, according as the Sun's Poſition is farther or nearer the *Solſtices*; and therefore nearer to the *Æquinoxes.* This *Inclination* doth caſt the conſtant *Current* of our Seas more to the North and South, and farther from it more to the Eaſt and Weſt; which is the Reaſon, why the *Current* up the *Iriſh-Sea* is nearer to the *Æquinoxes* (at the Beginning of *March*, and End of *Sept.*) and up the *Channel* or *narrow Seas*, farther from it, (at the Beginning of *Febr.* and of *Nov.*) and againſt the Coaſt of *Devonſhire* and thereabouts, at ſome intermediate time.

Animadverſions upon *Dr.* Wallis's Hypotheſis; *by Mr.* Joſ. Childrey, n.64.p.2061.

4. I fear Dr. *Wallis* may be miſtaken about the annual Viciſſitudes of the Tides, which he contendeth to be about *Allhallontide* and *Candlemas*; For,

1*ſt*, Our *Engliſh Seamen* (who are more to be truſted than the Inhabitants of *Romney-Marſh*) uſe to ſay, that the higheſt Tides in the Year ſeem to happen rather about the Æquinoxes, than thoſe two other aſſigned times, when the natural Days are longeſt and ſhorteſt.

2*dly*, If that which he ſuppoſeth ſhould be the Cauſe of the *High-Tides* he mentions at *London*, in *Nov.* 1660, and 1665, the like might be expected every *November*; and as frequently in *February*; of which he gives not one Inſtance. But thoſe High-Tides in the *Thames* in *November*, if we dare credit the *London Watermen*, are cauſed by the coming down of the *Land-Waters*, after a very great Rain; which, being encounter'd by the Tide of Flood from the Mouth of the *Thames*, cannot but ſwell to an unuſual Height. To induce us to believe which we need only conſider, that the latter End of *Octob.* and the Beginning of *Nov.* (or rather both thoſe whole Months) are generally the rainieſt Part of the whole Year. Now if the great Rains fall ſo that the Land-Waters come down to the flowing Part of the *Thames* juſt upon the Full or Change, when the Spring-Tides happen, as they did (for Example) *Sept.* 30. 1555. and *Octob.* 22. 1629, (*Stow* and *Howes* are my *Authors*) thoſe Spring-Tides muſt be the higher, as proceeding from a double Cauſe.

3*dly*, There

3. There is another thing notoriouſly known by all Seamen to be a Cauſe of *high* or *low Tides*, namely, the ſitting of the Wind at ſuch or ſuch a Point of Compaſs, and blowing hard. It is the conſtant Saying of all *Seamen* in *Kent*, that ever I met with, that the North-Weſt Winds make the *higheſt Tides* in the *Thames*, *Medway*, and all the Coaſts about the *South* and *North Forelands*; and likewiſe on the Coaſt of *Holland* and *Flanders*. And the Reaſon they alledge for it is, becauſe, ſay they, that Wind doth with equal Force blow in the Tide of Flood on both Ends of this Iſland of *Britain*; that is, from the Northward between the Coaſts of *Scotland*, *Norway*, and *Jutland*; and alſo from the Weſtward by the Coaſts of *Cornwal*, *Devonſhire*, *Dorſetſhire*, &c. up along the *Sleeve*; and for the ſame Reaſon they ſay (and I think truly) that a South-Eaſt Wind deads and hinders the Tides there. Agreeably to this I very well remember, when I was a Boy and lived at *Rocheſter*, that, when the *Tides* were unuſually high, the Wind was always *N. W.* and the Moon near the Full or Change. And the Inhabitants about *Chatham*, the Hundred of *Hoo*, and the Iſle of *Graine*, will with one Voice ſay, that they never fear their low *Marſhes* being overflowed by the *Tide* but when the Wind is at *N. W.* or thereabouts, upon the *Spring-Tides*. Here at *Weymouth*, thoſe able and antient *Seamen* I have talked with tell me, that a *S. S. E.* Wind makes the greateſt *Tides*; and that according to the Degrees of the Wind, *cæteris paribus*, the *Tides* riſe more or leſs notably, but that they never obſerve any extraordinary *ſwelling Tides* about *Allhallontide* or *Candlemas*, unleſs the Wind be about *S. S. E.* And the Reaſon they give for that Wind's raiſing the Tides there is, in my Opinion, very convincing, if we conſider the lying of the *Haven* in the *Map*. And for the ſame Reaſon, I ſuppoſe, the Wind from the ſame Point may make the *higheſt Tides* at *Southampton*; a Weſterly Wind at *Briſtol* and *Severne*; an Eaſterly Wind at *Hull*; a North-Eaſt Wind at *Wiſbych* and *Lynn*; a Southerly Wind upon the oppoſite Coaſts of *England*, and *Ireland*, &c. And I am confident, if more particular Enquiry be made in *Romney-Marſh*, it will be found, that *Dimchurch-Wall* is never in Danger of being overflowed or broken by the Tides, but upon very ſtormy and tempeſtuous Weather; eſpecially when the Wind either blows right upon the Shore, or when it ſits in that Point that raiſeth the Tides higheſt there. And if we do but conſider that *Allhallontide* and *Candlemas* are no more famous for the longeſt and ſhorteſt natural Days, than they are generally infamous for ſtormy Weather; eſpecially the former Seaſon, (*Wet* and *Windy* Weather being moſt concomitant) we have good Ground to attribute *High-Tides* at thoſe times of the Year to another Cauſe than the Author ſuppoſeth, and make a more than probable Conjecture at the Occaſion of the Miſtake. It is true, *March* is very often more ſtormy than *February* (tho' ſeldom ſo ſtormy as *October* and *November*) which poſſibly might occaſion that Opinion which ſome hold (of which Number *Pliny* is one) that the higheſt Tides are about the Æquinoxes. And if the Thing were found to hit pretty frequently in *March*, Men might not be careful to obſerve the other Æquinox; tho' yet, it cannot be denied, that we have bluſtering Weather many times before *Michaelmas*. In Confirmation of all this that I have ſaid, concerning the *Influence* of

the Winds being conſiderable on the Tides, I ſhall add theſe following Collections of my own out of Hiſtories, Chronicles, *&c.*

1250. *Octob.* 1. (Saith *Holinſhead*) Upon the *Change* of the *Moon* was a moſt dreadful Inundation of the Sea, that did exceeding much hurt to *Holland* beyond Sea, *Holland* in *Lincolnſhire*, and the *Marſh-Ground* in *Flanders*, and drowned *Winchelſea.* But he tells us withal, that an unheard of Tempeſt of Wind accompanied it.

1555. *Sept.* 30. (Saith *Stow*) Was a notable Inundation of the *Thames*; but he ſaith withal, that it was by occaſion of a great Wind and Rain that had fallen; the Moon was in *Perigæo.*

15$\frac{62}{70}$. *March* 10. I find this Manuſcript Note in Latin in an Ephemerides for that Year, over againſt the Day; *Septentrionis maxima Sævitia: Nivis flocci magni, ingens frigus. Maxime* tumeſcebat æſtus Maris *die & nocte, nam excurrebat in Agros late.*

1592. *Sept.* 6. *Wedneſday*, (ſaith *Stow*) the Wind being Weſt and by South, as it had been for 2 Days before, very boiſterous, the *Thames* was made ſo void of Water, by forcing out the Freſh, and keeping back the Salt, that Men in diverſe Places might go 200 Paces over, and then fling a Stone to Land, *&c.*

1600. *Decemb.* 8. I find this Note written in another Ephemerides for that Year, over againſt the Day; by an unknown Perſon; who, as it ſeems, was then at *Venice* (where a South-Eaſt Wind makes the higheſt Tides;) *Inundatio ventis 6. ped. temp. Sirocco.*

1601. (Saith *Grimſton* in his *Netherland Hiſtory*) The Sea, being forced in by a ſtrong *N. W.* Wind, did ſome Miſchief to *Oſtend.*

1601. *Octob.* 26. *St. n.* A great Tempeſt, ſaith the ſame Author, and the Wind *W. N. W.* and the Tide much higher than uſual at *Oſtend.*

1602. *Febr.* 23, 24. *St. n.* Blew a terrible North-Weſt Wind, which made the Water riſe higher than uſual at *Oſtend. Idem.*

1604. *March* 1. *n. ſt.* The Wind was very great at *Weſt* and *North-Weſt*, with a furious Tempeſt, the Tide at *Oſtend* riſing ſo high, as it had not done in forty Years before. *Idem.*

The *Perigæoſis* of the Moon alſo ſeems to have, at leaſt, ſome Influence on the *Tides*, and to make them ſwell higher than elſe they would do. For I have found by obſerving the Tides, as often as I had leiſure, ſeveral High-Tides and *Inundations*, tho' I muſt not ſay all, to happen upon the Moon's being in or very near her *Perigæum.* For Example;

That famous Inundation mentioned before out of *Holinſhead*, 1250. *Oct.* 1. was when the Moon was in *Perigæo*, as appears by Calculation.

1630. *Nov.* 5. That Inundation, on which was made the Diſtich,

> *Anno ter deno poſt ſequemille, Novembris*
> *Quinta, ſtat ſalſis* Zelandia *tota ſub Undis.*

as when the Moon was in Perigæo.

155$\frac{1}{2}$. *Jan.* 13. The *Sea*, ſaith *Mitchell* in his Chronicle, broke in at *Sandwich*, and overflowed all the *Marſhes* thereabout, and drowned much Cattle; the Moon in Perigæo.

1570. *Nov.* 1. Was a dreadful Flood at *Antwerp*, and on all the Coaſts of *Holland*, that made infinite Spoil; the Moon in Perigæo.

1600. *Dec.* 8. Such another as above mentioned; the Moon in Perigæo.

160$\frac{6}{7}$. *Jan.* 20. Was a great *Inundation* in *Severne*, mentioned in *How*'s Chronicle; that did much Hurt in *Somerſetſhire* and *Glouceſterſhire*, *&c.* the Moon in Perigæo.

1643. *Jan.* 23. *ſt. n.* ſaith a little *Low-Dutch* Chronicle that I have, was a terrible High-Water Flood in *Frieſland*, *&c.* whereby much Hurt was done to the *Dykes*; and at *Gaes*, by *Haerlingen*, the dead Bodies ſtreamed out of the *Earth*; the Moon in Perigæo.

1651. *Feb.* 23. *ſt. n.* (ſaith the ſame Chronicle) was St. *Peter*'s high Flood, whereby much Hurt was done to the Dykes in *Frieſland*, *Embderland*, and elſewhere; not far from *Dockum*, by *Oudt-woudumer Ziil*; is a Breach of 42 Roods long, broken in the Dyke; the Moon in Perigæo.

1657. *Aug.* 2. *ſt. v.* At *Feverſham*, where I then lived, was a very high Spring-Tide; and yet the Wind was at South-Eaſt, which deads the Tides there; the Moon in Perigæo.

1658. *Aug.* 22. *ſt. v.* At *Feverſham* was a very High Tide in the Afternoon, tho' the Wind was Southerly, and blew very ſtiff, which the Seamen there wondered at; the Moon in Perigæo.

1661. Upon *Michaelmas* Day was a great Overflowing of the *Severne*, that it drowned the lower Ground lying by it; I lived then in *Glouceſterſhire*, and immediately, as ſoon as I heard of it, I noted it down in my *Memorandum*; the Moon in Perigæo.

The Scheme of the *Weather* printed in the *Hiſtory of the* R. S. tells us, that *May* 24, 1663. was a very great Tide at *London*. But it tells us withal, that the ſame Day the Moon was in Perigæo.

1669. *Sept.* 19. Here at *Weymouth* I obſerved myſelf a very high Tide, and ſo did ſeveral Seamen in that Town, who wondered at it, the Weather being very calm, and that little Wind that was being at North-Eaſt, which uſes to contribute nothing at all to the Tides in that *Haven*; the Moon in Perigæo.

Farther, that, which inclines me to believe that the Perigæoſis of the *Moon* is of ſome Concernment in this Matter, is, becauſe it is a *Maxim* amongſt our *Kentiſh Seamen*, that they never have two running Spring-Tides (as they call them) together, but that the next Spring-Tide, after a high running Spring, is proportionably weak and ſlack; which, if true, is very correſpondent to my Opinion; becauſe if the *Moon* be in *Perigæo* at this *Spring-Tide*, ſhe ſhall be in *Apogæo* at the next. Accordingly I have received this Account at *Weymouth*, that this preſent *Feb.* 16$\frac{62}{70}$, the Spring-Tides ran very high after the *Change*, though the Weather was pretty calm, and that Wind that was not very favourable to the Tides, and the Spring-Tides after the Full were very low and weak, which is exactly according to my Conjecture.

But I conceive that the beſt *Touch-Stone* to prove the Soundneſs of my Opinion (which I confeſs I never had the Opportunity to do yet) is to have it obſerved, whether thoſe Neap-Tides be not apparently higher, *conſideratis conſiderandis*, that happen at the Moon's being in *Perigæo*, either at the firſt or laſt Quarter; becauſe it is a received and demonſtrable Truth in *Aſtronomy*, that the Moon being in *Perigæo* at either Quarter comes then nearer the Earth, than when it is in *Perigæo* at the Change or Full.

Anſwered by *Dr.* **Wallis**, ibid. p. 2068.

(5.) That the *Winds* have a great Influence on the Tides of particular Coaſts and Havens, I do not at all queſtion; and the like I ſay of *Land-Waters*, which are, as to Inland Rivers, very conſiderable, eſpecially as to Inundations upon riſing of the Water; for that the Tide and Land Flood ſhould jointly make a greater Inundation than either ſingly would have done, is not to be doubted. But in my Eſſay I take no notice of theſe; becauſe, my Buſineſs was to give a ſtatical Account of ſtated Periods, *Diurnal*, *Menſtrual*, *Annual*, ariſing from regular Motions, not of accidental Extravagancies, ſuch as theſe are.

The *Moon's Perigæoſis* alſo is far from being contrary to my *Hypotheſis*: But for as much as it doth not ſtill fall out at the ſame Time of the *Day*, *Month*, or *Year*; I could not make it component of any of thoſe noted Periods, *Diurnal*, *Menſtrual*, or *Annual*; and of more Periods than theſe I did not know that there hath been any general Notice taken, of which I might think myſelf obliged to give an Account: But it may very well influence any or all thoſe, according as it falls out advantageous or diſadvantageous for them.

And as I do ſo readily concur with him in all the Particulars by him ſuggeſted; ſo I think he will not be difficult in aſſenting to all the Materials of my *Hypotheſis*. The Account which I give of the *Diurnal* and *Menſtrual* Periods, from the common Center of the Gravity of the Earth and Moon, he doth allow as very rational; and conſequently, which is the Foundation of it, that any *Acceleration* or *Retardation* of the compound Motion of the particular Parts in the Earth's Surface, is to give ſuch an *Accumulation* of Waters as cauſeth a Tide; and the Complication of ſuch *Accelerations*, and *Retardations*, concurring or interfering one with another, doth occaſion the perplex Varities in them.

If therefore there be no other Periods of Tides but theſe, or no other remarkable, my Work is done, and I need not be farther ſolicitous: For then there will ſeem to be either no other Inequality of *Motions*, or none conſiderable. But, if there be alſo obſervable an *Annual* Period (as perhaps there may be) then are we to ſeek for the Cauſe thereof in ſomewhat of Inequality, (for the *Annual* Period annually recurs; or for any other Period) which doth ur in ſuch a time as that other Period doth require.

Tis true, I have not inſiſted on the *Moon*'s Apogæum and Perigæum, with e Inequality of *Motion* depending on it; or the *Obliquity* of its *Orb*, which aiſeth another Inequality both in the Motion of the *Longitude* and *right Aſcen*-*n*; becauſe I did not know any periodical Viciſſitude of Tides conſonant ereunto. When any ſuch ſhall be diſcovered, we have here a Founda- n ready for the ſalving it. And I the rather think they may be conſiderable, becauſe the *Earth* and *Moon's Appropinquation* and *Elongation* doth really alter the Diſtance of the common Center of Gravity of the *Earth* and *Moon* from the Earth, rendering the Earth's Epicycle elliptical; and much favours what Mr. *Childrey* obſerves of the Moon in Perigæo. But, as to any annual Viciſſitude, it is not of Uſe, becauſe it doth not annually recur.

But if the annual *High-Tides* be at the *Æquinoxes*, not at the times I have aſſigned, then ſo much of the *Hypotheſis* as concerns the *Excentricity* may be ſpared, (or allowed to be ſo little as not to be remarkable) and that of the *Obliquity* alone will give a ſufficient Account of it. Or if (to which he ſeems rather to incline) there be no ſuch annual Viciſſitudes at all; then may that of the *Obliquity* be ſpared alſo, and yet the *Hypotheſis* be perfect without it. And, 'till ſome ſuch be obſerved and acknowledged, it will be ſufficient to ſay, That tho' both the *Excentricity* and *Obliquity* do cauſe ſome Inequality in the Motion, yet ſo little, as that in the Tides it is not remarkable; they falling juſt as if the three Motions (Annual, Menſtrual, Diurnal) were all exactly circular, and on parallel Axes.

But, as to Matter of Fact in *Romney-Marſh*, I ſay, that according to the beſt Account I can there get, and the unanimous Conſent as well of Fiſhermen, and other Watermen, as of other Inhabitants, it is conſtant; hardly miſſing (or very ſeldom) any one Year, be the Weather fair or foul: And as well about *Candlemas*, as about *Allhallontide*, every Year, tho' not then ſo high: Of which, tho' they do not pretend to give any Reaſon of it, I think a Cauſe may be very rationally aſſigned. For, if you conſult the Tables of the *Inequality of natural Days*, which Parallel I make uſe of for the Explication of this, you will find, that about one of the Extremes, in *Jan.* the Increaſe and Decreaſe of the natural Days fluctuates very much, ſometimes increaſing, ſometimes decreaſing, according as this or that of the two Cauſes, thwarting one another, doth prevail: But about the other Extreme, in *October*, it is much otherwiſe; the Increaſings and Decreaſings going on in a continual Courſe for a long time together. And the ſame Cauſes, applied to the Buſineſs of *Tides*, may very rationally be ſuppoſed to produce as unequal Effects. And tho' the Seamen at *Weymouth* have not obſerved any ſuch ſignal Effects about *Allhallontide* and *Candlemas*, yet thoſe about *Chepſtow* obſerve the like to happen about the Beginning of *March*, and End of *Sept.* the one as much before the Vernal, as the other is after the Autumnal Æquinox, (like as in our Caſe it happens) which they call by the Name of St. *David's-Stream*, and *Michaelmas-Stream*; as we do thoſe in *Kent*, *Candlemas-Stream*, and *Allhallon-Stream*. Of theſe different Seaſons at *Chepſtow-Bridge*, from thoſe of *Romney-Marſh*, I have already given my Remarks. But ſince it is not yet (it ſeems) agreed, whether ſuch an Annual *Phænomenon* happen; or if ſo, not at that time; ſo that, for ought yet appears, it may be at the Seaſons I deſign, that is, between the *Winter Solſtice*, and the two *Æquinoxes* on either Side of it, though on ſeveral Coaſts ſeverally remote; I think it beſt to let this Part of the *Hypotheſis* ſtand as it is unrevoked, as that which when it ſhall be diſcovered, and agreed on, ſtands ready enough to give a rational Account of it, and, in the mean time, does no hurt. And, in ſuch a Complication of Cauſes ſo abſtruſe, ſcarce any thing but Obſervation will determine, which of the Cauſes, and in what Degree, is to be adjudged predominate.

Mr. Newton's Theory of the Tides explained by Mr. Halley. n.226.p.445

VI. The ſole Principle, upon which Mr. *Newton* proceeds to explain moſt of the great ſurpriſing Appearances of Nature, is no other than that of Gravity, whereby in the Earth all Bodies have a Tendency towards its Center; and there is the like Gravitation towards the Center of the Sun, Moon, and all the Planets.

Now this Force of a Deſcent decreaſes, as the Square of the Diſtance of the heavy Body from the Center increaſes.

There is alſo Room to ſuſpect, that the Force of Gravity is, in the *cæleſtial Globes*, proportional to the Quantity of Matter in each of them.

p. 445.

From theſe Principles it is evident, that if the *Earth* were alone, that is to ſay, not affected by the Actions of the Sun and Moon, the Ocean, being equally preſſed by the Force of *Gravity*, towards the Center, would continue in a perfect *Stagnation*, always at the ſame Height, without either *ebbing* or *flowing*; but the Sun and Moon having a like Principle of *Gravitation* towards their Centers, and the *Earth* being within the *Activity* of their *Attractions*, it will plainly follow, that the Equality of the Preſſure of *Gravity* towards the Center will thereby be diſturbed; and though the Smallneſs of theſe Forces, in Reſpect of the *Gravitation* towards the *Earth's Center*, renders them altogether imperceptible by any Experiments we can deviſe; yet the Ocean being fluid, and yielding to the leaſt Force, by its riſing ſhews where it is leſs preſſed, and where it is moſt preſſed by its *ſinking*.

Now if we ſuppoſe the Force of the *Moon's Attraction* to decreaſe, as the Square of the *Diſtance* from its *Center* increaſes (as in the *Earth* and other *cæleſtial Bodies*) we ſhall find, that where the Moon is perpendicular either above or below the *Horizon*, either in *Zenith* or *Nadir*, there the Force of *Gravity* is moſt of all diminiſhed; and conſequently that there the Ocean muſt neceſſarily ſwell by the coming in of the Water from thoſe Parts where the Preſſure is greateſt, *viz.* in thoſe Places where the Moon is near the *Horizon*. Thus let *M* be the Moon, *E* the Earth, *C* its Center, and *Z* the Place where the Moon is in the *Zenith*, *N* where in the *Nadir*. Then by the *Hypotheſis* it is evident, that the Water in *Z*, being nearer, is more drawn by the Moon than the Center of Earth *C*, and that again more than the Water in *N*; wherefore the Water in *Z* has a Tendency towards the Moon, contrary to that of *Gravity*, being equal to the Exceſs of the *Gravitation* in *Z*, above that in *C*: And, in the other Caſe, the Water in *N*, tending, leſs towards the Moon than the Center *C*, will be leſs preſſed, by as much as is the Difference of the *Gravitations* towards the Moon in *C* and *N*. Thus rightly underſtood, it follows plainly, that the *Sea*, which otherwiſe would be *ſpherical*, upon the Preſſure of the Moon, muſt form itſelf into a *ſpheroidal* or *oval* Figure; whoſe longeſt Diameter is where the Moon is vertical, and ſhorteſt where ſhe is in the *Horizon*; and that, the Moon ſhifting her Poſition as ſhe turns round the Earth once a Day, this *Oval* of

Fig. 56.

Water ſhifts with her, occaſioning thereby the two Floods and Ebbs obſervable in each 25 *Hours*.

And this may ſuffice, as to the general Cauſe of the *Tides*; it remains now to ſhew how naturally this Motion accounts for all the Particulars that has been obſerved about them; ſo that there can be no Room left to doubt, but that this is the true Cauſe thereof.

The *Spring-Tides* upon the New and Full-Moons, and *Neap-Tides* on the Quarters, are occaſioned by the attractive Force of the Sun in the New and the Full conſpiring with the Attraction of the Moon, and producing a *Tide* by their united Forces: Whereas in the Quarters the Sun raiſes the Water where the Moon depreſſes it, and the contrary; ſo as the *Tides* are made only by the Difference of their Attractions. That the Force of the Sun is no greater in this Caſe, proceeds from the very ſmall Proportion the Semi-Diameter of the Earth bears to the vaſt Diſtance of the Sun.

It is alſo obſerved, that, *cæteris paribus*, the *Æquinoctial Spring-Tides* in *March* and *Sept.* or near them, are the higheſt, and the *Neap-Tides* the loweſt; which proceeds from the greater Agitation of the Waters, when the fluid *Spheroid* revolves about a *great Circle* of the *Earth*, than when it turns about in a leſſer Circle; it being plain, that if the Moon were conſtituted in the *Pole*, and there ſtood, that the *Spheroid* would have a fixed Poſition, and that it would be always High-Water under the *Poles*, and Low-Water every where under the *Æquinoctial*: And therefore the nearer the Moon approaches the *Poles*, the leſs is the Agitation of the Ocean, which is of all the greateſt, when the Moon is in the *Æquinoctial*, or fartheſt diſtant from the *Poles*. Whence the Sun and Moon, being either conjoined or oppoſite in the *Æquinoctial*, produce the greateſt *Spring-Tides*; and the ſubſequent *Neap-Tides*, being produced by the Tropical Moon in the Quarters, are always the leaſt *Tides*; whereas in *June* and *Decem.* the Spring-Tides are made by the Tropical Sun and Moon, and therefore leſs vigorous, and the *Neap-Tides* by the *Æquinoctial* Moon, which therefore are the ſtronger. Hence it happens, that the Difference between the *Spring* and *Neap-Tides* in theſe Months is much leſs conſiderable, than in *March* and *September*. And the Reaſon why the very higheſt *Spring-Tides* are found to be rather before the *Vernal*, and after the *Autumnal Æquinox, viz.* in *Feb.* and *Oct.* than preciſely upon them, is, becauſe the Sun is nearer the *Earth* in the Winter Months, and ſo comes to have a greater Effect in producing the *Tides*.

Hitherto we have conſidered ſuch Affections of the *Tides* as are univerſal, without Relation to particular Caſes; what follows from the differing Latitudes of Places will be eaſily underſtood by the following Figure.

Fig. 57. Let *Ap E P* be the *Earth*, covered over with very deep Waters; *C* its *Center*; *P p* its *Poles*; *A E* the *Æquinoctial*; *F f* the *Parallel* of *Latitude* of a Place; *D d* another *Parallel* at equal Diſtance on the other Side of the *Æquinoctial*; *H h* the two Points where the Moon is *vertical*; and let *K k* be the great Circle wherein the Moon appears *Horizontal*. It is evident, that a *Sphæroid* deſcribed upon *H h* and *K k* ſhall nearly repreſent the Figure of the *Sea*, and *C f*, *C D*, *C F*, *C d*, ſhall be the *Heights* of the *Sea* in the Places, *f*, *D*, *F*, *D*, *F*, *d*, in all which it is High-Water: And ſeeing that in 12 Hours time, by the diurnal Rotation of the Earth, the Point *F* is transferred to *f*, and *d* to *D*, the Height of the Sea *CF* will be that of the High-Water when the Moon is preſent; and *CF* that of the other High-Water, when the Moon is under the Earth; which in the Caſe of this Figure is leſs than the former *CF*.

And in the oppoſite Parallel *Dd*, the contrary happens. The riſing of the Water being always alternately greater and leſs in each Place, when it is produced by the Moon declining ſenſibly from the *Æquinoctial*; that being the greateſt of the two High-Waters in each diurnal Revolution of the Moon, wherein ſhe approaches neareſt either to the *Zenith* or *Nadir* of the Place: Whence it is, that the Moon in the *Northern* Signs, in this Part of the World, makes the greateſt *Tides* when above the Earth, and in the *Southern* Signs, when under the Earth; the Effect being always the greateſt where the Moon is fartheſt from the *Horizon*, either above or below it. And this alternate Increaſe and Decreaſe of the *Tides* has been obſerved to hold true on the Coaſt of *England*, at *Briſtol* by Capt. *Sturmy*, and at *Plymouth* by Mr. *Colepreſs*.

But the Motions hitherto mentioned are ſomewhat altered by the Libration of the Water, whereby, though the Action of the *Luminaries* ſhould ceaſe, the *Flux* and *Reflux* of the Sea would for ſome time continue. This Conſervation of the impreſſed Motion diminiſhes the Differences that otherwiſe would be between the two conſequent *Tides*, and is the Reaſon why the higheſt *Spring-Tides* are not preciſely on the New and Full Moons, nor the *Neaps* on the Quarters; but generally they are the *third Tides* after them, and ſometimes later.

All theſe things would regularly come to paſs, if the whole Earth were covered with Sea very deep: But, by reaſon of the Shoalneſs of ſome Places, and the Narrowneſs of the *Streights*, by which the *Tides* are in many Caſes propagated, there ariſes a great Diverſity in the Effect, and not to be accounted for, without an exact Knowledge of all the Circumſtances of the Places; as of the Poſition of the Land, and the Breadth and Depth of the Channels by which the *Tide* flows; for a very ſlow and imperceptible Motion of the whole Body of the Water, where it is, for Example, 2 Miles deep, will ſuffice to raiſe its Surface 10 or 12 Feet in a *Tide*'s Time; whereas, if the ſame Quantity of Water were to be conveyed upon a Channel of 40 Fathoms deep, it would require a very great Stream to effect it in ſo large Inlets as are the *Channels* of *England* and the *German Ocean*; whence the *Tide* is found to ſet ſtrongeſt in thoſe Places where the Sea grows narroweſt, the ſame Quantity of Water being to paſs through a ſmaller Paſ- e: This is moſt evident in the Streights between *Portland* and *Cape de gue* in *Normandy*, where the *Tide* runs like a Sluice, and would be yet more ween *Dover* and *Calais*, if the *Tide* coming about the Iſland from the rth did not check it. And this Force, being once impreſſed upon the ter, continues to carry it above the Level of the ordinary Height in *Ocean*, particularly where the Water meets a direct Obſtacle, as it does at

St. *Malo's*; and where it enters into a long Channel, which running far into the Land grows very ſtrait at its Extremity, as it is in the *Severn Sea* at *Chepſtow* and *Briſtol.*

This Shoalneſs of the Sea and the intercurrent Continents are the Reaſons, that in the open Ocean the time of High-Water is not at the Moon's Appulſe to the Meridian, but always ſome Hours after it; as it is obſerved upon all the *Weſt Coaſt* of *Europe* and *Africa*, from *Ireland* to the *Cape of Good Hope:* In all which a *S. W.* Moon makes High-Water, and the ſame is reported to be on the *Weſt-Side* of *America.* But it would be endleſs to account all the particular Solutions, which are eaſy *Corollaries* of this *Hypotheſis*; as why the *Lakes*, ſuch as the *Caſpian Sea*, and *Mediterranean Seas*, ſuch as the *Black Sea*, the *Straits*, and *Baltick*, have no ſenſible *Tides:* For *Lakes*, having no Communication with the *Ocean*, can neither increaſe or diminiſh their *Water*, whereby to riſe and fall; and *Seas*, that communicate by ſuch narrow Inlets, and are of ſo immenſe an Extent, cannot in a few Hours Time receive or empty *Water* enough to raiſe or ſink their Surface any thing ſenſibly.

Vid. infra. §. XI.

Laſtly, The Cauſe of theſe extraordinary *Tides* in the Port of *Tonqueen* in *China* is propoſed by Mr. *Newton* to be from the Concurrence of two *Tides*; the one propagated in ſix Hours, out of the great *South-Sea*, along the Coaſt of *China*; the other out of the *Indian-Sea*, from between the Iſlands, in twelve Hours, along the Coaſt of *Malacca* and *Cambodia.* The one of theſe *Tides*; being produced in *North* Latitude, is, as has been ſaid, greater, when the Moon being to the *North* of the *Æquator* is above the Earth; and leſs, when ſhe is under the Earth: The other of them, which is propagated from the *Indian-Sea*, being raiſed in *South* Latitude, is greater, when the Moon declining to the *South* is above the Earth; and leſs, when ſhe is under the Earth. So that of theſe *Tides*, alternately greater and leſſer, there comes always ſucceſſively two of the greater, and two of the leſſer together every Day; and the High-Water falls always between the Times of the Arrival of the two greater Floods, and the Low-Water between the Arrival of the two leſſer Floods. And the Moon coming to the *Æquinoctial*, and the alternate Floods becoming equal, the *Tide* ceaſes, and the Water ſtagnates: But, when ſhe has paſſed to the other Side of the *Æquator*, thoſe Floods, which in the former Order were the leaſt, now becoming the greateſt, that that before was the Time of High-Water now becomes the Low-Water, and the Converſe. So that the whole Appearance of theſe ſtrange *Tides* is, without any Forcing, naturally deduced from theſe Principles.

Under-Currents *in the* Downs, *at the* Straits-Mouth, *and in the* Baltick; *By* Dr. Tho. Smith, n. 158. p. 564.

VII. (1.) In the *Offing* between the *North-Foreland* and *South-Foreland* it runs *Tide* and *half-Tide*; that is, it is either ebbing Water or Flood upon the Shore, in that Part of the *Downs*, three Hours, (which is, groſly ſpeaking, the time of half a *Tide*) before it is ſo off at Sea. And it is a moſt certain Obſervation, that, where it flows *Tide* and *half-Tide*, tho' the *Tide* of Flood runs aloft, yet the *Tide* of Ebb runs under Foot, that is, cloſe by the Ground; and ſo at the *Tide* of Ebb it will flow under Foot.

There is a vaſt Draught of Water poured continually out of the *Atlantick* into the *Mediterranean*, the Mouth or Entrance of which between *Cape Spartel* or *Sprat*, as the Seamen call it, and *Cape Trafalgar* may be near 7 *Leagues* wide, the *Current* ſetting ſtrong into it, and not loſing its Force 'till it runs as far as *Malaga*, which is about 20 Leagues within the *Streights*. By the Benefit of this *Current*, tho' the Wind be contrary, if it does not overflow, Ships eaſily turn into the *Gut*, as they term the narrow Paſſage, which is about 20 Miles in length. At the end of which are two Towns, *Gibraltar* on the Coaſt of *Spain*, which gives Denomination to the *Streights*, and *Ceuta* on the *Barbary* Coaſt: At which Places *Hercules* is ſuppoſed to have ſet up his *Pillars*. What becomes of this great Quantity of Water poured in this way, and of that which runs from the *Euxine* into the *Boſphorus* and *Propontis*, and is carried at laſt thro' the *Helleſpont* into the *Ægean* or *Archipelago*, is a curious Speculation, and has exerciſed the Wit and Underſtanding of Philoſophers and Navigators. For there is no ſenſible riſing of the Water all along the *Barbary* Coaſt even down to *Alexandria*, the Land beyond *Tripoli* and that of *Egypt* lying very low, and eaſily overflowable. They obſerve indeed, that the *Water* riſes 3 Feet, or 3 Feet and half, in the *Gulf of Venice*, and as much or very near as much all along the *Riviera* of *Genoa*, as far as the River *Arno:* But this rather adds to the Wonder.

My Conjecture is, that there is an *Under-Current*, whereby as great a quantity of Water is carried out, as comes flowing in. To confirm which, beſides what I have ſaid above about the Difference of *Tides* in the *Offing*, and at the Shore in the *Downs*, which neceſſarily ſuppoſes an Under-Current, I ſhall preſent you with an Inſtance of the like Nature in the *Baltick Sound*, as I received it from an able *Seaman*, who was at the making of the Trial.

(3.) He told me, that being there in one of the King's *Frigates*, they went with their *Pinnace* into the middle Stream, and were carried violently by the *Current:* That ſoon after they ſunk a Bucket with a large *Cannon Bullet* to a certain Depth of Water, which gave Check to the Boat's Motion; and ſinking it ſtill lower and lower, the Boat was driven a-head to the Windward againſt the upper Current; the Current aloft, as he added, not being above 4 or 5 Fathom deep; and that the lower the Bucket was let fall, they found the under Current the ſtronger.

The irregular Flux and Reflux of the Euripus, *by* F. Jac. Paul Babin. n.71. p. 2153.

VIII. The *Euripus* is a Streight of the *Ægean Sea*, ſo narrow, that a *Galley* can ſcarce paſs thro' it under a Bridge, built between the *Citadel* and the *Donjon* of *Negropont*. But not only this Place, where the Bridge is, is called the *Euripus*, but alſo 10 or 12 Leagues on each Side of it, where, the *Channel* being more large, the inconſtant Courſe is not ſo ſenſible as at the Foot of the *Caſtle*. For 3 or 4 Leagues on each ſide there are found 6 or 7 Gulphs, wherein this *Water* ſhuts itſelf up, to iſſue from thence as often as it enters there; and the Situation of theſe Gulphs contributes to the oddneſs of this Flux and Reflux, of which the Moon ſeems to be the principal Cauſe.

There are 20 Days of each Moon in which the Courſe of the *Euripus* is regular, and 10 in which it is irregular; that is to ſay, 5 Days before, and 5 Days after the *New* and *Full Moon*, the Courſe of it is irregular and ſtrong. And then you ſee there the like *Phænomena* with thoſe of the *Ocean* at *Bour-*

deaux. The Sea hath 2 Fluxes and Refluxes in 24 Hours, and every Day it retardeth almoſt an Hour: But there are 9 or 10 *Changes* of the *Courſe* of the Water during the remaining 10 Days of *Inequality*, unleſs it blow hard, and then the Courſe changeth not above 6 or 7 times. I once ſtaid on the *Mill*, which is under the Bridge, 1½ Hour, and I ſaw the Courſe of the Water change thrice, though the Wind was pretty high, and the Wheels of the Mill turned as often diverſe ways. M *de la Hogue*, a *Pariſian* Gentleman, being curious, ſtaid there almoſt a whole Day, with a *Janizary*; and, the *Moon* being near the *Full*, he obſerved the ſame thing that happens in the *Ocean*. But tho' he deſigned to ſtay there full 24 Hours, during the irregular Days, he was diſſuaded from it, for fear of the *Turks* that might take him for a Spy, and do him ſome Miſchief.

The Water riſeth not much above a Foot; and when it riſeth it runs into the Sea, and when it ſinks it flows into the *Channel*, going towards *Conſtantinople*.

The ſmall Gulphs, that are on the left ſide of the Port of *Negropont*, are filled when the Water riſeth; and emptied, running towards *Theſſalonica* or *Conſtantinople*, when it deſcend. *F. Vaubois* took notice of the ſame at *Conſtantinople*, *viz.* That the Waters of the *Black Sea*, that come from *Conſtantinople*, drive the *Euripus* in its riſing towards the main Sea, and that thereafter the Waters retire themſelves towards the ſame place again from whence they came. The ſame Perſon alſo obſerved, that the ſwelling of the *Euripus*, which is irregular, laſted not above a good Quarter of an Hour, and the ſinking thereof three good Quarters, though then the Water ran with more Rapidity, and ſeemed to him to come away in thrice as great Plenty as when he ſaw it riſe. I know not whether this proceeded from the Wind, not being able to aſſure you that this Effect is ordinary.

Between the Aſcent and Deſcent there is a little Interval, wherein the Water ſeems to be at reſt, and ſtagnating; ſo that, if there be no Wind ſtirring it, bits of Wood and Straw lie ſtill upon the Water without Motion.

From what I have ſaid 'tis not difficult to reconcile the *Authors* that have written ſo differently of the *Euripus*. For thoſe that have ſaid, that there is nothing in it but what is ſeen in the *Ocean*, that is, two Fluxes and Refluxes in 24 Hours, have only obſerved it in thoſe 20 Days of its Regularity. And the Ancients have not delivered a Falſhood, when they ſay, that there are 7 *Reciprocations* in one Day, becauſe that happens when the Winds trouble and ratard the Courſe of the Water: And I do aſſure, by often reiterated Obſervations, that when 'tis ſtill *Weather*, the Flux and Reflux is made even to 9 or 10 times in a natural Day.

Extraordinary Tides *about the* **Orkneys,** *communicated by Sir* **R. Moray. n. 98. p. 6139**

IX. In *Fairay-Sound*, betwixt the Iſles of *Fairay* and *Ætha* in *Orkney*, the Sea runneth North-Eaſt, for the Space only of 3 Hours in flowing, and 9 Hours South-Weſt in ebbing. This is the Courſe of the Tide only in the middle of the *Sound*, which is but one Mile broad.

Whilſt the Sea runneth from Weſt to Eaſt in flowing thro' *Weſtra Firth*, which is 8 Miles in Breadth, there are no greater *Surges* than in any other

Place of the Sea; and in a calm Day it is as ſmooth as any Lake, though there is conſtantly a great *Current* in the *Flux* and *Reflux* of the Sea. Yet at the South-Eaſt End of a little Iſland on the S. E. Side of *Weſtra*, and about a Mile from it, the Sea no ſooner begins to run Weſtward in Ebbing, but there beginneth a *Surge* to appear, which continually encreaſeth until the Ebb be half ſpent, and afterwards it decreaſeth until it be low Water; at which time there appeareth no ſuch thing. Eaſt and Weſt from this great Surge there are ſome few leſſer *Surges* ſeen, which are gradually leſs toward the Eaſt and Weſt. I having occaſion to paſs that way in a little Boat, when we had paſt over the Eaſtmoſt *Surges*, and were beginning to aſcend the biggeſt, upon the 10th of *April*, at one of the Clock in the Afternoon, the *Surge* before us was ſo high, that it intercepted the Sight of the Sun, and ſome *Degrees* of the Firmament above it. The *Surge* is about a quarter of a Mile in Length. When there is any Wind, which occaſioneth the breaking of the Tops of the *Surges*, there is no paſſing that way. The Current of the Tide is ſo ſtrong there, that there is no need of Sails or Oars, ſave only to direct the Boat as the Helm doth.

Extraordinary Tides in the Weſt Iſles of Scotland. *By Sir* Rob. Moray. n. 4. p. 53.

X. In that Tract of Iſles on the Weſt of *Scotland*, call'd by the Inhabitants *the long Iſland*, as being about 100 Miles long from North to South, there is a Multitude of ſmall Iſlands, ſituated in a Fretum or *Firth* that paſſes between the Iſland of *Euſt* and *Herris*; amongſt which there is one called *Berneray*, ſome three Miles long, and more than a Mile broad, the Length running from Eaſt to Weſt, as the *Firth* lies. At the Eaſt End of this Iſland, where I ſtaid ſome 16 or 17 Days, I obſerved a very ſtrange Reciprocation of the *Flux* and *Reflux* of the Sea, and heard of another no leſs remarkable.

Upon the Weſt-ſide of *the long Iſland* the *Tides* which came from the S. W. run along the Coaſt Northward; ſo that, during the ordinary Courſe of the *Tides*, the *Flood* runs Eaſt in the *Firth* where *Berneray* lies, and the *Ebb* Weſt. And thus the Sea ebbs and flows orderly ſome 4 Days before the *Full Moon* and *Change*, and as long after the ordinary *Spring-Tides*, riſing ſome 14 or 15 Foot upright, and all the reſt proportionably, as in other Places. But afterwards, ſome 4 Days before the *Quarter-Moons*, and as long after, there is conſtantly a great and ſingular *Variation*: For then (a Southerly *Moon* making there the *full Sea*) the *Courſe* of the *Tide* being Eaſtward when it begins to *flow*, which is about 9½ of the Clock, not only continues ſo 'till about 9 3½ in the *Afternoon* that it be *High-Water*, but after it begins to ebb the *Current* runs on ſtill *Eaſtward*, during the whole Ebb, ſo that it runs Eaſtward 12 Hours together; that is, all Day long, from about 9½ in the Morning 'till about 9½ at Night. But then, when the Night *Tide* begins to flow, the *Current* turns and runs Weſtward all Night, during both Flood and Ebb, for ſome 12 Hours more, as it did Eaſtward the Day before. And thus the *Reciprocations* continue, one *Flood* and *Ebb* running 12 Hours Eaſtward, and the other 12 Hours Weſtward, 'till four Days before the *New* and *Full Moon*; and then they reſume their ordinary regular *Courſe* as before, running Eaſt during the 6 Hours of *Flood*, and Weſt during the 6 of Ebb. And this I obſerved curiouſly, during my Abode upon the Place, which was in the Month of *Auguſt*, as I remember.

But the Gentleman, to whom the *Iſland* belongs at preſent, and diverſe of his Brothers and Friends, knowing and diſcreet Perſons, and expert in all ſuch parts of Sea matters, did aſſure me, that whereas between the *Vernal* and *Autumnal Æquinoxes*, that is, for ſix Months together, the Courſe of *irregular Tides* about the Quarter-Moons is to run all Day, that is 12 Hours, as from about 9½ to 9½, 10¼ to 10¼, *&c.* Eaſtward; and all Night, that is 12 Hours more, Weſtward, during the other ſix Months, from the Autumnal to the Vernal Æquinox; the Current here runs all Day Weſtward, and all Night Eaſtward.

At Tonqueen, *by Mr.* Fr. Davenport, n. 162. p. 667.

XI. (1.) During my Stay at *Batſha*, having (without Intermiſſion) obſerved the daily Courſe of the Tides, my Advice is, that upon the ſeveral following Days of the Moon's Age, in every particular Month of the Year, no *Engliſh* Commander ſhould, upon any Occaſion whatſoever, adventure over this *Bar*, unleſs he have a Pilot from the Shore, who undertakes to bring him in; or that he hath only Charge of ſome ſmall *Bark* or *Junk*, that draws no more than 8 or 9 Foot Water.

In the $\left.\begin{matrix}1\\7\end{matrix}\right\}$ Moons, from the $\left\{\begin{matrix}3\\17\end{matrix}\right.$ to the $\left.\begin{matrix}7\\21\end{matrix}\right\}$ days of the *Moon's Age excluſively.*

In the $\left.\begin{matrix}2\\8\end{matrix}\right\}$ Moons, from the $\left\{\begin{matrix}1\\14\end{matrix}\right.$ to the $\left.\begin{matrix}5\\18\end{matrix}\right\}$ days of the *Moon's Age excluſively.*

and from the 27 to the *Firſt* of the } Moon's *excluſively.*

In the $\left.\begin{matrix}3\\9\end{matrix}\right\}$ Moons, from the $\left\{\begin{matrix}11\\25\end{matrix}\right.$ to the $\left.\begin{matrix}15\\29\end{matrix}\right\}$ days of the *Moon's Age excluſively.*

In the $\left.\begin{matrix}4\\10\end{matrix}\right\}$ Moons, from the $\left\{\begin{matrix}9\\23\end{matrix}\right.$ to the $\left.\begin{matrix}13\\27\end{matrix}\right\}$ days of the *Moon's Age excluſively.*

In the $\left.\begin{matrix}5\\11\end{matrix}\right\}$ Moons, from the $\left\{\begin{matrix}7\\21\end{matrix}\right.$ to the $\left.\begin{matrix}11\\25\end{matrix}\right\}$ days of the *Moon's Age excluſively.*

In the $\left.\begin{matrix}6\\12\end{matrix}\right\}$ Moons, from the $\left\{\begin{matrix}5\\19\end{matrix}\right.$ to the $\left.\begin{matrix}9\\23\end{matrix}\right\}$ days of the *Moon's Age excluſively.*

And, excepting on theſe ſix Days above-mentioned, in every reſpective Moon, he may ſafely adventure over the *Bar* any Day, provided always that he miſtake not the Time of the Tide, but come over at half Flood or better, tho' he may take notice that the beſt Tides will be about ſix or ſeven Days after the Water's firſt beginning to increaſe; and the firſt Days of the Water's Increaſe are,

In the	1 7	Moons, on the	5 19	days	of the Moon's Age.
In the	2 8	Moons, on the	3 16	days	
In the	3 9	Moons, on the	13 27	days	
In the	4 10	Moons, on the	11 25	days	
In the	5 11	Moons, on the	9 23	days	
In the	6 11	Moons, on the	7 21	days	

The *Bar* itſelf being about a Mile and half in Length, and no where, except in its firſt Entrance, exceeding half a Mile in Breadth, is very even, but yet affords conſiderably differing Soundings in the ſame Age and Time of the Tides, according to the Seaſon of the Year (and, which ſeems to be ſomewhat ſtrange, hath the higheſt Tides in the Northerly *Monſoon*, as I have been informed by thoſe who are ſeemingly beſt able to give an account thereof) and I muſt needs ſay, that the Trial I made on the Bar in *July*, 1678, did accord with what I underſtood from ſeveral of the Fiſhermen, and others, as to that Month, which induced me to enter this *Information*; and coming over at half Flood, except on the Days afore-mentioned as dangerous to come over in, there will be found according to the Age of the *Tides*,

In the	3 4 5	Moons,	from 16 to 21 Feet Water.
In the	6 7 8	Moons,	from 19 to 24 Feet.
In the	9 10 11	Moons,	from 22 to 27 Feet.
In the	12 1 2	Moons,	from 17 to 22 Feet.

Always the higher the Flood, the lower the Ebb; ſo that, according to the Strength of the Tides at *Low-water*, the *Soundings* are from 6 to 13 Feet.

On the firſt and ſecond Days at the Water's *Increaſe* the *Influxes* are very ſmall and uncertain, but afterwards the *Tides* for 13 Days are *conſtant* in their *Courſe*, one *Flood* and one *Ebbing* being compleated in 24 Hours time, equally ſharing the Space of a *Lunar Circuition* of the Earth between them, and every *Flood* beginning neareſt $\frac{3}{4}$ of an Hour later than the precedent *Flood*, and alſo conſiderably increaſing in the height of the *Tide* every Day from the 3d unto the 6th and 7th Days of the *Water's* Age, on which two Days the Flood runs very high; but on the 8th Day (which may be accounted the laſt of the *Spring-Tides*) the Waters begin gradually to decreaſe again, retaining the ſame ordeely Difference of Time in each Tide, until the next following firſt Day of the Water's *Increaſe*; when, during two Days unſettledneſs, there is a ſhifting of the *Tides* in reſpect of the Beginning of the *Flood* and *Ebb*; after which ſaid ſhifting a Conſtancy in their inverted Courſe is again retained in the above-mentioned Order for 13 Days following; as for Example,

On the 25th and 26th Days of the 4th *Moon* (4th and 5th of *June*, 1678, ☽ in the latter end of ♈) being the firſt Days of the Water's *Increaſe*, the *Influxes* were very ſmall, there happening on the 26th a falling back of the Tides about 13 Hours. But from the 27th (*June* 6th) which was the third Day of the Water's *Increaſe* after the *laſt Quarter*, until the 9th Day of the 5th *Moon's Age* (*June* 18, 1678. ☽ in ♎ 20.) I noted a very conſtant *Courſe* in the Tides, every Flood beginning with the Riſing of the *Moon*, and ending at its Setting; the following *Ebb* in like manner continuing during the Time of the *Moon's* Age (*June* 18, 1678.) being the firſt Day of the Water's *Increaſe*, their Motion was ſcarcely perceptible; on the 10th Day there was another falling back of the *Tides* neareſt 13 Hours, and on the 11th Day (which was the third Day of the Water's *Increaſe*, after the firſt *Quarter* of the Moon's Age) the Flood, having (as I ſaid) ſhifted the preceding Day, took its turn to begin at the Moon's Setting, and end at its Riſing; and accordingly the Tides ſucceſſively following aſſumed and kept a conſtant Regularity, the Tides being at higheſt the 16th of the Moon (1678. *June* 24. ☽ in the middle of ♑) which was the 7th of the Water's Age, until the 23d of the ſaid Moon's Age (*July* 1, 1678.) on which, being the firſt Day of the Water's *Increaſe*, the *Influx* was again ſcarcely diſcernible for its Smallneſs.

N. B. This Bar of *Tonqueen* is about 110 Degrees of *Longitude* to the Eaſt of *London*, and in the *Lat.* 20°. 50′.

On the 24th Day the *Tides* fall back, as I had found it twice before to have done on the ſame Days of the *Water's Age*, neareſt 13 Hours, by which means the *Flood* on the 25th Day, which was the third Day of the *Water's Increaſe* after the laſt *Quarter* of the Moon, now again commenced with the riſing Moon, whereby it hath fallen out always to be *High-water* between Noon and the following Midnight every Day, during my Stay here. (☾ *Laſt Quarter* 22 Days, ☽ *Firſt Quarter* 8 Days.)

So that it may paſs into a Corollary, *viz.* In the 4th, 5th, and 6th *Changes* of the Moon, from the third Day of the *Water's Age* after the laſt Quarter, to the third Day of the *Water's Age* after the firſt Quarter of the following Moon, the Water begins to flow when the Moon riſeth, and to ebb again when it ſetteth in the Horizon; and the contrary to the third Day of their Age after the laſt Quarter, excluding always their Motion on the two firſt Days of the *Water's Increaſe*, becauſe of its Smallneſs and Uncertainty.

I am informed by the *Inhabitants* hereabouts, that this may hold for a Rule from the 2d to the End of the 7th *Moon*, and that the Converſe thereof holds true in the other 6 *Months* of the Year, *viz.* from the 8th to the End of the *firſt Moon:* According to which the *Tides* will fall out to be at the higheſt in the *Evening* for 6 *Months* ſucceſſively, and the other half Year in the *Morning*; that is to ſay, between *Midnight* and the following *Noons.* And tho' I cannot aver the Truth of it, yet I find that the *Tide* laſt Year in the 11th *Moon* (which occaſionally, upon the Ship *Eagle's* departure hence, I took ſome notice of) did fall out, not diſagreeing with what they affirm: And I am yet the rather induced to believe, that in every annual Revolution there may be ſuch a Conſtancy in this different Motion of the Tide appropriated to each Moiety of rhe Year, becauſe that, during my —— Days Stay at *Batſha*, I have found the Predictions of the Natives confirmed by my own Obſervations of the Tides falling out to be High-Water always between *Noon* and the ſucceeding *Midnight*, occaſioned by the aforeſaid falling back at the End of 15 Days; ſo that on every third Day of the *Water's Increaſe* the Flood begins at the Hour whereon the Day before it ended.

To prevent Miſtakes in the Accompt of the *Moons*, it may be ſufficient to inform thoſe who uſe this Port, that the *firſt Change* of the *Moon* after the 15th Day of *January*, *O. S.* is reckoned for the beginning of the Year, and that *Moon* being accounted the firſt, the reſt follow in order until the Expiration of the 12th, which compleats their Year; except only in their *Leap-Years*, and then they have 13 *Moons*, taking in one extraordinary to make up the Deficiency of the *Moon's Epact* in their Accompt; in which Years the firſt Day of their *New-Year's-Moon* falls out before the ſaid 15th Day of *January*, as it did this Year, 1678, upon the 12th, being *Leap-Year* with them; ſo that they reckoned two Months for one this Year; that is to ſay, the 2d and 3d *Moons* after their *New-Year's-Day* they called 2d *Moons*; for otherwiſe this preſent *Moon*, which changed in *July* the 8th, would have been the 7th; whereas now they count it but the 6th *Moon*, and accordingly do the Tides fall out. But this Leap-Year being paſt, the firſt Moon in the Year muſt be reckoned to begin on the Change next following the 15th of *January*, and all other Changes counted ſucceſſively, as before ſaid, until the *Intervention* of another Leap-Year.

A Theory of the Tides at Tonqueen. *By Mr.* Edm. Halley, ibid. p. 685.

2dly, The Effect of the *Moon* upon the Waters, in the Production of the *Tides* in this Port of *Tonqueen*, is the more wonderful and ſurpriſing, in that it ſeems different in all its Circumſtances from the general Rule, whereby the *Motion* of the *Sea* is regulated in all other Parts of the *World* I have yet heard of. For firſt, each *Flux* is of about 12 Hours Duration, and its correſpondent Reflux as long; ſo that there is but one *High-Water* in 24 Hours. Then there are in each *Month* two *Intermiſſions* of the *Tides*, about 14 Days aſunder, when there is no ſenſible Flood or Riſing of the Waters to be obſerved; but the Sea is in a Manner ſtagnant. *Thirdly*, That the *Increaſe* of the Water has its 14 Days Period between the aforeſaid *Intermiſſions*, and that at 7 Days End makes the *higheſt Tides*; from which time the *Water* again gradually abates, and the Flood is weaker till it comes to a *Stagnation*; both *Increaſe* and *Decreaſe* obſerving the ſame Rule, in being exceeding ſlow in their Beginning and End, and ſwift in the Middle. *Laſtly*, And, which is moſt odd, the riſing Moon in the one half of each Month makes High-water, and the ſetting Moon in the other half. Thoſe Particulars conſidered, together with the Tables ſhewing the Days of the *Water*'s *Stagnation* in each Month, gave me a light into the Secret of this ſtrange Appearance, ſo as to be able to bring the hitherto unaccountable Regularity of theſe Tides to a certain Rule.

And *Firſt*, it appears by the latter of the two Tables, that the *Intermiſſions* of the *Tides* happen nearly upon thoſe Days that the Moon enters the Signs of *Aries* and *Libra*, or paſſes the *Æquinoctial*; which divides the Moon's Courſe nearly into 2 equal Parts, as well as the *Sun*'s; and from hence it follows, that the *Tropical Moons* in ♋ and ♑ are thoſe which occaſion the greateſt *Flux* and *Reflux*; and for the Rule of the Change of the Time of *High-water*, which Mr. *Davenport* calls *a falling back of the Tides*, the Example he hath given us lets us know, that the ☾ in *Northern Signs* brings in the Flood, whilſt ſhe is above the *Horizon*, ſo as to make *High-water* at her *ſetting*; and, on the contrary, that whilſt ſhe is in *Southern Signs* it flows all the time the Moon is below the Horizon, and ſo makes *High-water* at her *riſing*. But it is to be obſerved, that tho' the Motion paſſes ſwiftly from *South* to *North* when ſhe is in or near ♈, and from *North* to *South* in or near ♎, yet the Motion of the Sea, which is the Cauſe of this *Tide*, is ſcarce diſcernable for 3 or 4 Days, when the Moon paſſes the ſaid *Æquinoctial Points*; whence it appears, that tho' the Declination of the ☾, or her Diſtance from the *Æquinoctial*, be that whereby the *Tides* are regulated, yet the *Increaſe* and *Decreaſe* of the Water is by no means proportionable to that of the *Declination* of the ☾; that changing ſwiftly where the *Increaſe* of the Water is obſerved to be moſt ſlow. It ſeems therefore, and I propoſe it as a probable Conjecture, that the *Increaſe* of the *Waters* ſhould be always proportionate to the *verſed Signs* of the double Diſtances of the *Moon* from the *Æquinoctial Points*; upon which *Hypotheſis Fig*. 58. will give an elegant *Synopſis* of the whole Matter. Let *AB* be the bottom of the *Bar* of *Tonqueen*; *C D* a Perpendicular thereto, whereon to meaſure the ſeveral Depths of the *Water*; *C* ♈, *C* ♎, the mean Depth, which is that whereat the *Water* is *ſtagnant* upon the *Moon*'s being upon the *Æquinoctial Points*, being commonly about 15 Feet: The *C* ♋ *occid.* the *High-water Mark*, when the *Moon* is in ♋ or ♑, being about 24 Feet: *C* ♑ *occid.* the height of the *Low-water Mark*, when the *Moon* is in ♋ or ♑, being about 6 Feet; ſo that the greateſt Riſe of the *Water* on the *Tropical Moons* will be about 18 Feet; then dividing ♈ ♋ and ♎ ♑, into equal Parts, in *E F*, on thoſe two Points, as *Centers*, deſcribe the two *Circles*, each of whoſe *Radii* are four Feet and a half, which, being kept between the Compaſſes, naturally divide the ſaid Circles in the Points, ♉, ♊, ♋ ♌; through the which Points, if you draw Lines parallel to the *Baſe A B*, they ſhall cut the Perpendicular *C D* in the Heights of the High and Low-water Marks, which will be at the Entrance of the Moon into the ſaid Signs. So the greateſt Depth of the *High-water*, when the Moon enters ♉, ♏, ♌, ♓, is but 17¼ Feet, and the leaſt at *Low-water*, 12¾ Feet: But when ſhe enters ♊, ♌, ♐, ♒, the *High-water*

Water Depth is 21¼ Feet, the *Low-water* is 8¼ Feet; as appears by the *Figure.* And this *Hypotheſis* not only agrees with all that Mr. *Davenport* hath obſerved himſelf, or collected from the Natives, but hath been found to hold true ſince, in the Year 1682, by the ingenious Capt. *Knox* in his Voyage to this Port; ſo that there is no room to doubt of the Truth thereof. (1.) By this Method may the Time and Height of the *Tides* be with ſufficient Certainty computed: But to philoſophize thereon, and to attempt to aſſign a Reaſon why the Moon ſhould, in ſo particular a manner, influence the Waters in this one Place, is a Task too hard for my Undertaking; eſpecially when I conſider how little we have been able to eſtabliſh a genuine and ſatisfactory *Theory* of the *Tides* found upon our own Coaſts, of which we have had ſo long Experience.

The differing Gravities *of* Sea-water *according to the Climates, by* * * * n.18. p.315.

XII. Mr. *Boyle* having recommended this Matter, among others, to a learned Phyſician that was ſailing into *America*, and furniſhed him with a ſmall *Hydroſtatical Inſtrument*, to obſerve from time to time the Differences of Gravity he might meet with, this Account was returned him; that he found by the Sea-Glaſs the Sea-Water to increaſe in Weight the nearer he came to the Line, 'till he arrived at a certain Degree of *Latitude*; as he remembers, it was about the 30th; after which the Water ſeemed to retain the ſame *ſpecifick Gravity*, 'till he came to *Barbadoes*, or *Jamaica*.

A Way to make Sea-water *ſweet, by Mr.* Hauton, n. 67. p. 2048, 2050.

XIII. Mr. *Hauton* hath now declared his Secret of making Sea-water ſweet. It conſiſts firſt in Precipitation made with the *Oil* of *Tartar*, which he knows to draw with ſmall Charges. Next, he diſtills the Sea-water; in which the Furnace taketh up but little room, and is ſo made, that with a very little Wood or Coal he can diſtill 24 *French* Pots of Water in a Day; for the cooling of which he hath this new Invention, that, inſtead of making the Worm paſs through a Veſſel full of Water (as is the ordinary Practice) he maketh it paſs through one Hole, made on purpoſe out of the Ship, and to enter in again through another; ſo that the Water of the Sea performeth the cooling Part; by which Means he ſaveth the room which the common *Refrigerium* would take up; as alſo the Labour of changing the Water when the Worm hath heated it. But then, Thirdly, he joins to the two precedent Operations Filtration, thereby perfectly to correct the Malignity of the Water. This Filtration is made by Means of a peculiar Earth, which he mixes and ſtirs with the diſtilled Water, and at length ſuffers to ſettle at the Bottom.

He maintains, that his diſtilled *Sea-water* is altogether ſalubrious: He proveth it firſt from Experience, it having been given to Men and Beaſts ithout any ill Effect at all upon them. Secondly, From Reaſon grounded n this; that that peculiar Earth, being mixed with the diſtilled Water, lunts the Points of the *volatile Spirits* of the *Salt*, and ſerveth them for heaths, if I may ſo ſpeak, taking away their Force and *malign* Sharpneſs.

Sea-water *made* Freſh *by Dr.* Mart. Liſter, n. 156. p. 493. De Font. Med. Angl.

XIV. It ſeems probable to me, that the Sea-water was the only Element eated at the *Beginning*, before any *Animal* or *Vegetable* was created, or the an itſelf. But, upon the Creation of theſe, the freſh Water had its Riſe cidentally, becauſe it owes its Being in great Part (as I have elſewhere ſhewn)

ſhewn) to the Vapours of Plants, and the Breath of Animals; and the Exhalations raiſed by the Sun. Now, that the Sea-water is made freſh by the Breath of Plants growing in it, I thus demonſtrated: I took a long Glaſs Body, and having filled it pretty full with Sea-water, taken up at *Scarborough*, I put therein common Sea-weed (*Alga Marina*) freſh and new gathered, ſome with the Roots naked, and ſome growing on and adhering to Stones. The Glaſs Body being full I put thereon a *Head* with a *Beek*, and adapted a Receiver thereto, all without any Lute or cloſing of the Joints; from theſe Plants did diſtill daily (though in a ſmall Quantity) a freſh, very ſweet, and potable Water, which hath no *Empegreuma*, or unpleaſant Taſte, as all thoſe diſtilled by Fire neceſſarily have.

This I take to be the moſt natural, moſt eaſy, and moſt ſafe way of having ſweet Water from the Sea; and which may be of great Uſe, even to ſupply the Neceſſity of *Navigators*. And I do not doubt but there may be found other Plants growing in or near the Sea, which would yield freſh Water in much greater Quantities.

Wells of freſh Water *near the* Sea *at* Bermudas; *by Mr.* Rich. Norwood; n. 30. p. 656.

XV. We dig Wells of freſh Water ſometimes within 20 Yards of the Sea, or leſs, which riſe and fall upon the Flood and Ebb, as the Sea doth; and ſo do moſt of the Wells (as I am inform'd) though farther up in the Country. Whereſoever they dig Wells here, they dig 'till they come almoſt to a Level with the Superficies of the Sea, and then they find Water, either freſh or ſalt: If it be freſh, yet if they dig two or three Feet deeper, or often leſs, they come to Salt-water. If it be a ſandy Ground, or a ſandy crumbling Stone, that the Water ſoaks gently through, they uſually find freſh Water; but if they be hard *Lime-ſtone* Rocks, which the Water cannot ſoak through, but paſſeth in Chinks or Clefts between them, the Water is ſalt or brackiſh.

To examine the Freſhneſs *of* Water; *by Mr.* Boyle. n. 197. p. 627

XVI. (1.) When I remember'd and conſider'd, that (as I have found by various Trials) diverſe metalline and other mineral Solutions could be readily *precipitated*, not only by the *Spirit of Salt*, but by *crude Salt*, whether dry or diſſolved in Water; 'twas no very difficult Matter for me to think, that, by a heedful Application of the *precipitating* Quality of the common Salt, one might diſcover whether any Particles of it (at leaſt in a Number any way conſiderable) lay concealed in diſtilled Water, or any other propoſed to be examined. To this End I employed ſeveral Drugs, and thoſe not all prepared by one *Menſtruum*. And tho' two or three of my other Trials had Succeſſes that I diſliked not, when I made them, yet that, which at length I pitched upon as the moſt certain, and which therefore I meant, when I had the Honour to be ſent for by his Majeſty about the *Patentees Water*, was that which I think may be underſtood, as well as recommended, by this ſhort Narrative.

I took ſome common Water diſtilled in Glaſs Veſſels, that it might leave its corporeal Salt, if it had any, behind it, and put into a thouſand Grains of it one Grain of common dry Salt: Into a convenient Quantity, for Example two or three Spoonfuls, of this thus impregnated Liquor I let fall a fit Proportion, for inſtance 4 or 5 Drops, of a very ſtrong and well filtrated

Solution of well-refined *Silver*, diſſolved in clear *Aqua-fortis*; [for a ſhift common or *Sterling-Silver* will ſerve the turn;] and I made the Experiment ſucceed with Spirit of *Nitre*, inſtead of *Aqua-fortis*; upon which there immediately appeared a whitiſh Cloud, which, though but ſlowly, deſcended to the Bottom, and ſettled there in a white *Precipitate.* And to make the Experiment rather ſeverely, than at all favourably, there was uſually taken ſomewhat more than a thouſand Parts of Water to one of Salt.

But I obſerved, that, having let fall a few Drops of our *metalline Solution* into the Liquor obtained from Sea-water by the *Patentees* way of ſweetening it, there did not preſently enſue any white Cloud or *Precipitate*, much leſs ſuch an one as had been newly afforded by the Water that was impregnated with leſs than a thouſandth Part of Salt. And if, after ſome time, there happened to appear (for 'tis not abſolutely neceſſary it ſhould) a little Cloudineſs in this *factitious Liquor*, it was both ſlowlier produced, and much leſs, than that which appeared in the impregnated Water.

Perhaps it may be proper that I here obſerve (what is not wont to be taken notice of) That diverſe *Solutions* of *mineral Bodies* may be *precipitated* by *Dilution*; that is (to explain this Expreſſion) when the *Solution* has Time enough allowed to diffuſe itſelf through a great Quantity of Water, the *ſaline* Parts are thereby ſo *diluted* and weaken'd, that they are no longer able to ſuſtain the *mineral Corpuſcles* they kept ſwimming before, but make with them and the Water a confuſed and ſubſiding Mixture; uſually of a whitiſh Colour. This may appear, when the *Butter of Antimony*, being put into *common Water*, is thereby quickly and plentifully *precipitated* in the Form of that white Powder that *Chymiſts* (not over-deſervedly) call *Mercurius vitæ.* To which I may add, that I have alſo produced a Powder of that Colour, by pouring into *common Water* a ſtrong *Solution* of *Tin-Glaſs* made in *Aqua-fortis.* And by the ſame way we have *precipitated* the *Tincture* (or *Solutions* of the finer Parts) of *Jalap*, *Benjamin*, true *Labdanum*, *Antimonial Sulphur*, and divers other Bodies made in *Vinous Spirits.* If it were not for this Power that *Water* has to weaken moſt *Solutions* of Bodies, I could have employed, inſtead of that *Silver*, either *Quick-ſilver* diſſolved in *Aqua-fortis*, or *Lead* crude, or calcined in the ſame Liquor, or (which is more convenient) in ſtrong *Spirit* of *Vinegar*; ſince theſe and ſome others are found to be *precipitable* by *Salt-water* into whitiſh Powders. But though a very heedful Obſerver may for a ſhift make uſe of theſe *metalline Solutions* to gueſs at the Quality of Water, as to *Freſhneſs* and *Saltneſs*; yet the *Precipitation*, that is made by *Dilution*, is not difficult to be diſtinguiſhed from that which is performed by a true and proper *Precipitant* (as in our Caſe by the *common Salt* that is harboured in the Pores of the *Water*) both by the Quickneſs of the Effect, and the Copiouſneſs of the white Subſtance produced; and on both theſe Accounts is very much inferior to it; as may evidently appear in the very different Effects that our *Solution* of —— had upon the *Patentees Water*, compared with thoſe it had upon *Water* impregnated with a *thouſandth* Part of *Salt*, and upon divers common *undiſtilled Waters.*

But to return: The Uſefulneſs of this Experiment is not to be eſtimated only by the *Examen* it helps us to make of *dulcified Sea-water*, but much more by the Eſtimate that by its means may be made of *natural freſh Waters*, whether of *Springs*, *Rivers*, *Clouds*, *Lakes*, *Wells*, *&c.* For it being generally granted that thoſe Waters, *cæteris paribus*, are the beſt, as well for the Wholſomeneſs as divers Oeconomical Uſes, as *Waſhing*, *Brewing*, *&c.* that are freeſt from *Saltneſs*, which is an adventitious, and in moſt Caſes a hurtful Quality of *Waters*; by our way of *examining* theſe Liquors a heedful Eye may in a trice diſcover, whether there be any latent Saltneſs in them, (as moſt Waters imbibe from the Soil they have traverſed or do ſtagnate in) and may enable one, eſpecially by the Help of a little Practice, to give a near Gueſs, how much one Water is freſher than another, as I have purpoſely tried with Pleaſure in differing Waters, that are ordinarily drunk even by conſiderable Perſons. And if once you have attentively marked what Change four or five *Drops*, for inſtance, of our diſcovering Liquor will make in *Two* or *Three*, or ſome other ſmall determinate Number of *Spoonfuls* (or rather of *half Ounces*) of *Water*, 'twill not be difficult for a heedful Obſerver, keeping the ſame Proportion between the two Liquors, to make a near Eſtimate, whether any natural Water propoſed to him have a greater, an equal, or a leſs Degree of Freſhneſs or Saltneſs, than that Water that he has choſen for his Standard; and how much, in caſe there be a Difference, the propoſed Liquor is leſs or more free from Saltneſs than the other.

And that (to add this upon the by) ſuch a Difference in a Liquor of ſuch frequent inward Uſe as Water (which is the *Baſis* of *Beer*, *Ale*, *Mead*, and ſome other common *Drinks*) may have conſiderable Effects upon human Bodies in Reference to *Health*, may be probably argued from the differing Effects that Waters more or leſs impregnated with Salt have upon diverſe other Bodies: Since moſt *Pump-waters*, for inſtance, will not boil Peaſe, and Beef, and ſome other Aliments near ſo well as Spring-water or Rain-water, which are uſually ſofter, and more free from the Saltneſs we ſpeak of. 'Tis commonly known to Barbers and Laundreſſes, that the ſame *Pump-water* will not ſo well and uniformly, or without little Curdlings, diſſolve Waſhballs and Soap, as *Rain-water* and ſome *Running-waters* uſually will: Nay, when I was curious of *tempering Steel*, I remember, 'twas confeſſed by the skilfulleſt Artiſts I made uſe of, that ſome Tools (as Gravers, *&c.*) made of the hardeſt of *Metals*, would receive a differing *Temper* if they were quenched in *Pump-water*, from that, which the like Extinction in Spring-water or River-water would give them.

I might add on this occaſion, That, whereas Experience has inform'd ſeveral Perſons who have conſulted it, that diverſe *Medicinal Waters*, that are preſumed to own their Virtues to the Participation either of *Metalline* or of other *Mineral* Bodies, do upon *Trial* appear to leave ſometimes little, and ſometimes nothing behind them, except a kind of *common Salt*; our Precipitant may much aſſiſt Men to diſcover, whether a *Mineral Water* propos'd to be examin'd do or do not contain ſuch a *Salt*; and if it do, whether it contain it copiouſly, or no. This I have tried upon more than one of our *Engliſh Mineral Waters*, and thereby found in a trice, that one, that is reputed of another Nature, contained pretty Store of *ſaline Matter*; and that another, which is ſtill, for ought I have learned, of an unexamined and unknown Nature, is *impregnated* with a ſurpriſing Plenty of *ſaltiſh Subſtance*; but how, and with what *Cautions*, our *Precipitant* may be moſt uſefully employed, about the *Examen* of *medicinal* and other *mineral Waters*, belongs not to this Place. Upon which account I forbear to declare the Uſe I have ſometimes made of our *Precipitant*, in examining the *freſh Urine* of *Men*, the *Serum* of *human Blood*, and other Bodies belonging to what the *Chymiſts* call the *Animal Kingdom*.

I have not, for certain Reaſons, aſcribed to our Method of examining *Waters* a greater Nicety than to be able to diſcover *one* Part of *Salt* in a *thouſand* of *Water*, that Proportion being great enough to recommend it, and expreſſed by a round Number eaſy to be retained in one's Memory: Yet I would not have it thought but that, if it were requiſite, our *Method* may make more nice Diſcoveries. For having ſometimes, for Curioſity's Sake, put one *Grain* of *Salt* into no leſs than 1500 of diſtilled Water, we could manifeſtly, tho' not quite ſo conſpicuouſly as before, make it appear by our way, that even this ſo lightly impregnated Liquor was not devoid of *Salt*, but had more of that in it than ſome of the *Patentees Water*, that I kept by me, had; nay, I once found, that a *Grain* of dry *Salt* being diſperſed thro' 2000, and another time, that being diſſolved in 300 times its Weight of the ſame kind of Liquor, ſo inconſiderable a Proportion of *Salt* was plainly diſcoverable by our *Precipitant*.

It may be objected, That whereas the *Experiments*, hitherto mentioned, have been tried only upon *Waters* impregnated with groſs or corporeal *Sea-ſalt*; this perhaps may not hinder but that they may be imbued with the *Spirits* of *marine Salt*, which by reaſon of their Activity may be as unhealthful to the *Drinker*, as the groſſer Salt itſelf. But tho' to this Surmiſe I might anſwer, that a very ſmall Proportion of *Spirit* of *Salt* may in many caſes make the *Water* ſeaſoned with it rather *medicinal* than *unwholeſome*, yet I ſhall anſwer more directly to the Objection, by ſaying, that, to manifeſt its not being well grounded, I took above 1000 *Grains* of *diſtill'd Water*, and inſtead of *corporeal Salt* put to it one ſingle Drop of moderately ſtrong *Spirit* of *Salt* (for I had much ſtronger by me that I purpoſely declined to employ) and, having ſhak'd it into the *Water*, I let fall into a Portion of this unequally compoſed Mixture ſome Drops of our Solution of Silver, which preſently began to precipitate into a whitiſh Foam; inſomuch that, for ought appear'd to the *Eye*, this Trial ſucceeded better than if the Water had been impregnated with but the 1000th Part of *corporeal Salt*. The like *Experiment* was made with the *Patentees Water* inſtead of the other. And, to purſue this Trial a great way farther, I had the Curioſity to diffuſe one Drop of Spirit of Salt into 2000 Grains of diſtill'd Rain-water; and upon letting fall ſome Drops of our *Precipitant* into it I found that the Succeſs well anſwered my Expectation.

And then, to urge the Trial yet farther, I added as much of the ſame diſtill'd Rain-water, as by a modeſt Conjecture made it amount to at leaſt half as much more. So that one *Grain* of *Spirit* of *Salt* had a manifeſt Operation, though not quite ſo conſpicuous as the former, upon above 3000 *Grains* of *Water*, whoſe Immunity from common Salt we tried apart. And that a Drop of the *ſaline Spirit*, we made uſe of, did not equal in Weight a Grain of dry *Salt*, I found by this; that, having let fall into a counterpoiſed Piece of *Glaſs* ten Drops of that Spirit, I found them to want near half a Grain of 9 Grains Weight.

The like Trial I made by ſubſtituting above 1000 Grains of Rain Water in the room of the like Quantity of diſtilled Water.

It is the Opinion of ſome *Seamen*, and of a Perſon for whom I have a profound Reſpect, that *Water* ought to have a little *Saltiſhneſs* to preſerve it; if this be really a deſirable Quality in our *artificial Water*, it may in a trice be ſupplied with as much *Saltneſs*, whether *corporeal* or *ſpirituous*, as ſhall be required: and, conſequently, as will bring it to be equal in that Quality to the common *Water* of *Rivers* or *Springs*. And perhaps 'twill not be impertinent to add on this occaſion, that in ſome Places, eſpecially lying in hot Climates, it may ſometimes be of good Uſe to know, whether on the Account of the Sun's Heat, or that of the *ſubterraneal Regions* of the *Earth*, the *Rain-water* is impregnated with *volatile*, not *acid*, *Spirits*, like thoſe that are diſtilled from *Urine*, and which I have, for Curioſity's Sake, obtained from a mineral Body, *native Sal-armoniack*; upon which account I made a Trial that informed me, that if 5 or 6 Drops of *ſtrong Spirit of Urine*, whoſe Drops I obſerved to be but ſmall, were ſhaken into 1000 *Grains* at leaſt of Diſtill'd or Rain-water, impregnated but with one of *Salt*, our *Precipitant* would make a Diſcovery of ſome *Saltiſhneſs* in the *Liquor*. And if it were neither to be admir'd nor cenſur'd, if the *Patentees Water* ſhould ſometimes ſhew a *Change*, when our *Precipitant* is *plentifully* put, or long kept in it, eſpecially that *Change* being a more light one than that I came from ſpeaking of; ſince, for ought I have yet obſerved, not only ſuch *undiſtilled Waters* are generally allowed to be freely potable, but even thoſe that *Nature* herſelf diſtils are not always quite devoid of Saltneſs.

For I have found Rain-water, that I cauſed carefully to be ſaved after the Houſe-tops had newly been well waſh'd with former Rain, to grow a little troubled if any Store of our *Precipitant* were kept for ſome competent time in it. And being gently diſtilled off it left a Reſidence, which, with a little of our Solution, afforded a far more ſuddenly made and copious *Precipitate* than had been produced with the like Quantity even of Pump-water itſelf. And tho' have met with Rain-water that was more free from Salt than any Spring or River-water that I remember to have examin'd, yet having for Curioſity's Sake made Trial of Snow-water, which, if the Weather had been ſomewhat milder, would have been Rain; this Liquor, I ſay, which is thought to afford the lighteſt Water of all natural ones, I manifeſtly found, by our way of examining it, not to be devoid of Saltneſs.

It has been ſurmis'd by ſome, that even a moderate Action of the *Fire* upon *Water* will make it brackiſh, and putrify: But that the *Patentees Water* is not *brackiſh*, appears by the foregoing Trials; and that it is more free from Saltneſs than moſt of the Waters Men do without ſcruple drink: And that it may keep ſweet longer than is neceſſary, in a Ship that can from time to time within a few Days ſupply itſelf with freſh out of the *Sea*, may be gathered from theſe two things; The *firſt* is, That I cauſed a Pint of it to be *hermatically* ſeal'd in a Vial, whereof I left, by gueſs, about a third Part empty; and having about 6 *Weeks* after held this Veſſel againſt the *Light*, I found the *Water* to be clear and *limpid*; tho' I did not judge it had depoſited ſo much as the tenth Part of a *Grain* of *Feculancy*. And having opened the *Seal*, and taken out a little of the Liquor, I did not find it alter'd either as to *Smell* or *Taſte*. The *Second* is, that I have kept a *Bottle* of it in the ſame unſtopt Veſſel near eight *Months*, and yet it continues ſweet and well-conditioned. And if that which is called *Crudity* in *Water* does conſiſt (as probably it often does) in certain groſs Particles that are mingled with the purely aqueous ones, it is likely, that the Action of the Fire may divide and diſſipate theſe into minuter Particles, and thereby deſtroy the Texture that makes them hurtful; and, by cauſing innumerable Tumblings and Rovings amongſt the more earthy Particles, give them Opportunity to make little *Coalitions*, whoſe Weight precipitating them to the Bottom frees the pure Water from them.

And becauſe 'tis but too probable, that the *Unwholſomeneſs* of diverſe *Waters* proceeds not only, or perhaps not ſo much, from bare *Crudity*, as from a great Quantity of groſſer *Particles*, that are not eaſy to be raiſed becauſe of their being combined with fixed and earthy ones, that ſwim up and down in the *Water* they impregnate, as *Silver* or *Mercury* does in a *Solution* made with *Aqua-fortis*, or rather as the Particles of Salt do in *Pump-water*, and many other *common Waters*: On this Account, I ſay, the *Patentees* Invention may very much correct ſuch *Waters*, ſince, by their way of ſweetening thoſe Liquors, the truly aqueous Parts are not only freed from the ſaline ones, but from the mineral and other groſs and hurtful *Corpuſcles* that may have lain concealed in the Liquor. As may be argued from hence, that having purpoſely, in the gentle Fire of a digeſtive Furnace, ſlowly diſtilled off a Pound of the *Patentees Water*, it left us in the *Cucurbit* ſo light and thin a *Feculency*, that the *Bottom* of the Glaſs ſeemed to be rather ſullied than cover'd by it; and I did not judge that the whole *Feculency*, if we could have got it out, would have amounted to ſo much as two Grains.

Perhaps it was upon ſuch Reaſons that the laſt *Great Duke of Tuſcany*, when he drank *Water*, preferr'd for *Wholſomeneſs* that which was *diſtill'd* to that which was not; and, if herein that learned Prince and thoſe of the ſame Opinion were not miſtaken, it will highly recommend the Uſefulneſs of the *Patentees Invention* to Mankind: For there are Multitudes of *Waters* that are not conſiderably *brackiſh* to the Taſte, that yet, by reaſon of ſome unheeded *Saltneſs*, as in moſt *Pump-waters*, more frequently by reaſon of *Crudity*, are not only unfit, or at beſt leſs fit for diverſe *Oeconomical Uſes*, as *Waſhing*, *Boiling* of ſome *Meats*, &c. but are very unwholeſome; ſometimes to a Degree, that makes them miſchievous to whole *Communities*, and perhaps *Nations*. I remember I have ſeen a notable *Inſtance* of this in thoſe *huge* and *unſightly Tumours* about the *Throat*, which are obſerved by *Travellers* to be exceeding common among thoſe that inhabit the lower *Tracts* of Ground that lie between the *Rhætian*, *Helvetian*, and ſome other neighbouring *Mountains*; which monſtrous *Swellings* are generally imputed to the *Snow-waters* that flow from the *Mountains*, and make the uſual Drink of the meaner Sort of People; whence 'tis obſerved, that Perſons of better Condition, who drink *Wine* more than *Water*, are either not at all, or far leſs troubled with theſe *diſfiguring Goitres*, as they call them. But much more notable *Inſtances* to our preſent Purpoſe are afforded me by that great and yet living Traveller, M. *Tavernier*, Baron of *Aubonne*; who, ſpeaking of a Nation of *Cafres* or *Negroes* that come ſometimes to trade with the *Portugueſe* from a remote Part of *Africk*, informs us, *That the Water of their Country is very bad, which is* (ſays he) *the Reaſon that their Thighs do ſwell, and it is a wonder to ſee any of them free.* Nay, which is far more, where he ſpeaks of the *African* Kingdom, or Empire of *Monomotapa*, he has this memorable Paſſage, *The Natives never live long, by Reaſon of the Badneſs of the Waters in the Country. For at the Age of twenty-five they begin to be dropſical, ſo that 'tis a great Wonder if any among them live above forty Years.*

Theſe People might probably be much relieved, and be brought to live as long as other Nations, if they had ſo compendious a way as that of the *Patentees* to provide themſelves plentifully with Waters whoſe *Crudity* is corrected, its groſſer and heavier Parts ſeparated, and its *Brackiſhneſs* deſtroy'd by the Fire, as its Action is regulated and helped by their Invention.

The Experiment mention'd in this Paper was tried at a *Meeting* of the *R. S. Feb.* 17. 169½, by Dr. *Sloane*, with a Succeſs anſwerable to the Aſſertions of the honourable Author, and that Drop or two of Spirit of *Salt* mixed with *common Water* would be by the ſame Method diſcovered.

By Dr. Hook, ibid. p. 639.

(2.) At a *Meeting* of the *R. S. Mar.* 2. 169½. Dr. *Hook* read a Lecture concerning a Method of his own for the diſcovering the ſmalleſt Quantity of *Salt* contained in *Water*, from a Principle of *Hydroſtaticks*; and after his Diſcourſe thereof he produced the *Apparatus*, which he had prepared to exhibit the ſame, before the Perſons then preſent.

The *Method* of doing which *Operation* was by means of a large *Poiſe* of *Glaſs*, ſomewhat of the Shape of a *Bolt-head*, the *Ball* of which *B* was about 3 Inches Diameter, but the *Stem* or *Neck* thereof *C C* was not above $_2\frac{1}{4}$ of an Inch. This was ſo poiſed by red Lead put into it, as to make it but a little heavier than fair or freſh Water. Then this *Poiſe* was ſuſpended by the ſmall *Stem* to the End of a ſlender Beam *A*, which was very tender, and being not over-charged with Weight, would turn with a ſmall Part of a Grain. This *Beam* was hung on a *ſteady Frame*, and the *Poiſe* hanging at one End of the ſame, covered with the Water to a certain *Mark* or *Diviſion* made on the ſmall Neck at *D*, it was ſo counterpoiſed by ſome ſmall Weights put into the oppoſite Scale of the Ballance *F*. Then the *Weight* of the *Water* contained in the Ciſtern or Veſſel *EE*, into which the Poiſe was immerſed, being firſt known, a 2000th Part of its Weight was taken of common Salt, weighed out, and put into the whole 2000 *Parts* of the *Water*, which, by being ſtirr'd, ſoon diſſolved. Then the *Poiſe*, ſuſpended as before, was view'd and examined by many then preſent, and they manifeſtly ſaw, that near half an Inch more of the Neck emerged out of the *Water* ſo ſeaſoned, than did before the 2000th *Part* of *Salt* was *diſſolved* therein.

This was only one Uſe of this Method of diſcovering very ſmall *Alterations* in the *Conſtitution* of *Bodies*, the ſame *Author* having long ſince, namely, *Octob.* 25. 1677. ſhewn to the ſame Society a Method of diſcovering divers *Alterations* much more curious, namely to the 176000th *Part* of its *Weight*.

XVII. There is an old Spring in the Dioceſe of *Paderborn* in *Weſtphalia*, which loſes itſelf twice in 24 Hours; coming always after ſix Hours back again with a great Noiſe, and ſo forcibly as to drive three Mills not far from its Source. The *Inhabitants* call it the *Bolderborn*, as if you ſhould ſay, *the Boiſterous Spring*.

An Ebbing Well in Weſtphalia, *by* * * * n. 7. p. 127.

XVIII. *Lay-Well*, near *Torbay*, is about 6 *Foot* long, and 5 *Foot* broad, and near 6 *Inches* deep, which ebbs and flows very often every Hour, viſibly enough. I am informed, 'tis moſt conſtant Winter and Summer, tho' I am apt to think it moves faſter in Winter, when the *Well* is fuller, than in Summer: Becauſe, when I obſerved it firſt (in *July*, 1693.) I think it flowed ſomewhat quicker than I found it did on my ſecond *Obſervation*, toward the End of *Auguſt* following; for the *Water* was then conſiderably ſhrunk in the Well, notwithſtanding we had for about a Fortnight much Rain: And tho', when once it began to flow, it performed its Flux and Reflux in little more than a Minute's Time, yet I obſerved it would ſtand at its loweſt Ebb ſometimes two or three Minutes; ſo that it ebbed and flowed, by my Watch, about 16 Times in an Hour, and ſometimes I have been told 20. As ſoon as the *Water* in the *Well* began to riſe, I ſaw a great many Bubbles aſcend from the *Bottom*; but, when the *Water* began to fall, the Bubbling immediately ceaſed. I meaſured its High and Low-water Marks, and found them between five and ſix Inches diſtant; not of perpendicular Depth, but as it ſpread itſelf on a broad Stone, as the Sea does on a Beach or Shore. Tho' I am apt to think its perpendicular Height would be as much or more in that time, were its Out-let damm'd up to try an Experiment; for, as it riſes, it runs out with a ſmall Stream, which is greater or leſs, according as the Water in the *Well* riſes and falls.

That it has any *Communication* with the *Sea* is not manifeſt, nor is the *Water* brackiſh at all. The whole Country adjacent is very hilly all along the Coaſt; inſomuch that from *Brixham* to the Top of the Hill is about a Mile and half, and the Well is about half-way up the Hill (which hereabout is ſomewhat uneven and interrupted) and comes out at a ſmall Deſcent, yet conſiderably higher than the Surface of the Sea.

I tried it with an *Oaken Leaf* as ſoon as I ſaw it the firſt time, but could not find it change Colour. I drank of it; 'tis very ſoft and pleaſant, has no manner of Roughneſs in it, and ſerves for all manner of Uſes to the Country People in their Houſes; they alſo uſe it in Fevers, as their ordinary Diet-drink, which ſucceeds mighty well.

An Ebbing Well near Torbay, *by Dr.* W. Oliver, n. 104. p. 909, 910.

The Zirchnitzer Sea *in* Carniola *deſcribed by Dr.* Brown, n. 54. p. 1083. n. 109. p. 194.

XIX. (1.) Having croſſed the River *Dravus*, and paſſed Mount *Luibel* in the *Carnick Alps*, by that noble Paſſage cut thro' the Rocks and vaulted like that of *Pauſilyppe* near *Naples*, I went to *Brounizza*; two Leagues from whence, and beyond the Hills, is the *Zirchnitzer Sea*, receiving that Name from *Zirchnitz*, a Town of about 300 Houſes.

This Lake is near two *German* Miles long, and one broad. On the South Side thereof lies a great Foreſt, and on the North-ſide the Country is flat; but the whole Valley is encompaſſed with high Hills, at ſome little diſtance from it. But I ſaw no Snow upon them, tho' upon other Mountains in the Country I obſerved Snow in *June*. Upon Hills on the Side of great Lakes the Snow lies not ſo long as upon Hills more diſtant.

This *Lake* is well filled with Water for the greateſt Part of the Year, but in the Month of *June* it ſinketh under Ground, not only by *Percolation*, or falling thro' the Pores of the Earth, but retireth under Ground thro' many great Holes at the Bottom of it; the little, if any, that remains in the hilly or rocky Part is evaporated: And in the Month of *September* it returns by the ſame, and in a ſhort time covers the Tract of Earth again, but I cannot determine the Space of Time to a Day. This *Return* and *Aſcent* is ſo ſpeedy, and it mounteth at the Holes with ſuch Violence, that it ſprings out of the Ground to the Height of a Pike. The *Water* that ſpouts ſeems ſomewhat clear in the Air, but, being ſpread about, looks as formerly in the *Lake*.

The Holes generally are ſtony, not in ſoft or looſe Earth, yet in one or two Places the Earth hath been known to ſink and fall in, particularly near a Village called *Sea-dorf*. They are of different Largeneſs and Figure; ſome perpendicular at the Beginning, and then oblique; others oblique at firſt; ſcarce two exactly alike. Such Holes I have ſeen in other Parts of *Carniola*, and in other Countries alſo. We have a Hole call'd *Elden Hole*, not made by Art, but naturally, in the Mountains in the *Peak Country* of *Derbyſhire*, above 80 *Fathoms* deep. The great Holes are the ſame every Year, but poſſibly part of the Water may ſometimes find or make new Paſſages thro' the Crevices and cribrous Parts of the Field.

When the Water goeth firſt away, they ſee it in theſe Holes for a while, but afterwards it deſcends lower out of their Sight.

This Piece of Ground in the time of the Retirement and Abſence of the *Water* is not unfruitful, but, by a ſpeedy and plentiful Production of *Graſs*, yieldeth not only a preſent Suſtenance for the Beaſts of the Field, but a good Proviſion of *Hay* for the Cattle in *Winter*.

The *Lake* is not only thus filled with *Water*, but every Year well ſtored with *Fiſh*. The Prince of *Eckenberg* is Lord of it, and of much Country thereabout. But upon the retiring of the *Water* all have Liberty to fiſh; and the *Fiſhermen*, ſtanding up to the *Waſte* at the *Holes* before-mentioned, intercept the Paſſage of the *Fiſh*, and take a very great Number of them, which otherwiſe would be ſecure for ſome *Months* under the *Earth*, and not fail to return in *Sept*. But at that time the Prince will not permit them to make any ſuch Attempt.

The *Fiſh* of this *Lake* have a cloſer Habitation than thoſe of any other I know; for they paſs ſome Months under the Earth, and a good part of the

Winter under Ice. I could not learn that there were any *Otters* in this *Lake*, which otherwiſe muſt probably have taken the ſame Courſe with the *Fiſh*; not that there were any remarkable extraneous Subſtances, any Vegetables, or unknown Fiſhes brought up by the Water, but thoſe which come up are of the ſame Kind with thoſe which deſcend.

The Bottom of the *Lake* is not even, nor near about the ſame Depth; but ſometimes 2 Foot, and then ſuddenly 20 Yards deep. And, becauſe the Fiſh haunt the deep Places more than the Shallows, they have given Names to the ſeven chiefeſt Cavities or Valleys in the *Lake*.

The Water is not always at the ſame Height, but ſomewhat differing according unto Rain, Snows, or Drought; and they are ſenſible of its Height by the Tops of the Hills in it, and its ſpreading toward *Zirchnitz*, but it alters not very much 'till it begins to go away.

No River enters it, but only inconſiderable *Rivulets* on the South and Eaſt Side; nor hath it any other Diſcharge known, but by the Holes.

There are alſo divers Caverns and deep Places in the Country of *Carniola*, even where there is no Water.

Between *Sea-dorf* and *Nider-dorf* the Ground ſometimes ſinks in ſeveral Places upon the ſudden retiring of the *Lake*; and the aforeſaid Prince of *Eckenberg* was once ſo curious as to deſcend into one *Hole*, thro' which he paſſed under a Hill, and came out on the other Side; as I was informed by M. *Andreas Wiſer*, the preſent Judge of *Zirchnitz*, and alſo by *Johannes Wiſer*, who hath formerly held the ſame Place.

The Country is high about the Lake, but the Lake is not high in reſpect of the Country near it, but low.

The Snow falls not 'till after the Lake is return'd.

This *Lake* probably may hold Dependance of and Communication with ſome ſubterraneous great *Lake*, or *Magazine* of *Water*, belonging to theſe hilly Regions; which, when full and running over, may vent itſelf with Force and Plenty into this Field; and, when Scant of *Water*, abſorb and drink in the ſame again; the *Water* of the *Lake* returning but from whence it came, having no River running out of it whereby to be diſcharged.

I went alſo to a noted Stone, commonly call'd the *Fiſhers-Stone*, which hath ſomewhat of the Uſe of the *Nileſcope-pillar* at *Grand Cairo*. It is a large Stone upon one of the Hills, or elevated Parts of the Field; which, whenſoever it appears above *Water*, the *Fiſhermen* upon the *Lake* take notice of, and know thereby that in a few Days the *Water* will retire under Ground. For after the filling of the *Lake* in *September* the Water never decreaſeth ſo low again, to let the *Fiſher-ſtone* appear, 'till it begins to retire under Ground.

(2.) This *Lake* was by the *Antients* called *Lugea Palus*, by the Moderns *Lacus* *ugeus*, tho' at preſent its *Latin* Name be *Lacus Cirknicenſis*, in *High-dutch* *rchniſerſee*, and in our *Carniolan* Tongue *Zirkniſco Jeſero*. Why it was ſo call'd old is unknown, or very uncertain, but the *Original* of the preſent Name is ore ſure, it being derived from the adjacent Town of *Cirknits*, which took Name from a *Chapel* of the Virgin *Mary*, that at firſt ſtood alone, but ow the Town is built round it. This *Chapel* was no great Edifice at firſt,

By *M.* J. Weichard Valvaſor. n. 191. p. 411.

and therefore was called the *little Chapel*, which in the *Language* of the Country is *Zirkviza*; whence the *Lake* was named *Zirkviſco Jeſero*, or the *Chapel-Lake*, but now by Abuſe, *v* being changed into *n*, *Zirkniſco Jeſero*.

It is diſtant from the Capital City of the Province *Labac* 6 *German* Miles, is a good *German* Mile long, or better than 4000 *Geometrical Paces*, and is about half as much in Breadth. Its ordinary Depth is 10 *Cubits*, its leaſt 5 or 6, rarely 3, but its greateſt is 16 Cubits. It is every where ſurrounded with woody Mountains, which on the South and Weſt-ſide are very high, and 3 Miles broad, running far in length into the *Turkiſh* Country, and afford nothing but horrid ſtony Deſerts, overgrown with Trees. On the North and Eaſt Side there is between the Mountains and the Lake a ſmall Territory; which, tho' narrow, is nevertheleſs pleaſant, and is inhabited by 1 Town, 3 Caſtles, and 9 Villages, and adorned with 20 Churches; as may be ſeen in the
Fig. 60. Map, which was drawn by myſelf upon the Place with all poſſible Care.

In the Mountain called *Javornik*, ſtanding near the Lake, there are two *Holes*, or exceeding deep Precipices, in which many thouſand wild *Pigeons* rooſt all the Winter; entring in *Autumn*, and coming out with the firſt of the *Spring*: What they live upon in theſe *Caverns* is unknown, but I take it to be the *nitrous* Sand. In another Hole, called *Slivenza*, 'tis the Belief of the Country People, that the *Witches* hold their Aſſemblies, becauſe that ſeveral times Lights like *Ignes fatui* are obſerved there. On the Top of this Hill is a Hole of an unknown Depth, out of which there often breaths out noxious Hail; and for this Reaſon the *Prieſt* of *Zirknitz* every *Whitſon-Monday* goes to the Hole in Proceſſion, and uſes over it a certain Form of *Exorciſm*.

There run into this *Lake* continually 8 Rivulets. The two leaſt are called *Belleberch* and *Treſenz*; the third is the Fountain *Oberch*, out of which abundance of *Water* guſhes with great Force; the fourth, fifth, and ſixth, called *Steberziza*, *Linſinziza*, and *Seromſchiza*, may for their Bigneſs deſerve the Name of Rivers; the ſeventh, *Martinſchiza*, breaks out at a Cleft in the Rock: The laſt, called *Cirknizer-bach*, is a pretty large River.

Now this *Lake* being every where ſurrounded with Mountains, and no where running over, Nature has given it two viſible Channels, or ſtony Caverns, call'd *Velka-karlouza* and *Mala-karlouza*, by which the Water runs under the *Mountain*; and a third concealed ſubterraneous Paſſage, which without doubt communicates with the other two under Ground (as I ſhall hereafter prove.) Theſe, having run half a *German* Mile, come out at the other Side of
Fig. 61. the *Mountain*, near the *Chapel* of St. *Cantian*, as I have faithfully drawn it, in a *Deſert-place*, at a ſtony *Cave A*, and become the *River* called by the Inhabitants *Jeſero*, that is, the *Lake*. This River *Jeſero*, mark'd *B*, is reaſonably big, and, having run half a quarter of a Mile, enters a wide *ſtony Cavern I*, running ſlowly under the Hill for the Space of a good *Muſquet-ſhot*; then coming out again on the other Side, after it has run thro' a ſmall *Plat m m*, it enters a third *Cavern* or *Grotto C*, wherein having paſſed 50 Paces, one may ſay *Siſte Viator*, *ne plus ultra*; for it runs no longer *peaceably* as before, but with great Noiſe and Roaring falls down a very much inclined Channel of Stone, ſo that neither I nor any durſt follow it farther. In *June*, 1678. I went

myſelf in a ſmall Fiſher-boat under the Mountain through the Cave *I*, and entred the *Grotto C*, 'till I came to the aforeſaid Falls, without any Danger or Trouble, the Paſſage being wide enough.

It muſt be noted, that the Valley wherein this River *Jeſero* runs is exceeding ſteep, but the Plat of Ground *m m* is plain and ſtony, of an Oval Form, and is ſurrounded with (as it were) a very high Rampart *K K K*, ſo ſteep that it would be impoſſible for a Cat to climb out of it, unleſs at one Place, whereat a Man may make a ſhift to go up and down, tho' not without Peril of his Life; the way being in ſome Places not above three or four Inches, and no where above 6 Inches wide. In the Year, 1684. I went down here in Company with a *French* Gentleman; but the Water being up, and we wanting a Boat, we could not go under the Hill, nor enter the *Grotto C*; ſo we returned, and with great Difficulty deſcended by a ſteep and narrow Paſſage at *D*, and came to a Cave bigger than any Church, thro' which the River *Jeſero* runs. Here we found ſeveral Figures of Stone, the Workmanſhip of Nature, and ſtrange Holes and Caverns in the Earth; but, by reaſon the River was then up, we could go no farther. At other times, when the Water is down, one may go with lighted Torches a great way under Ground; and it is ſaid there are here very odd Figures formed by the petrified Water: Among the reſt one reſembling a Weaver at Work, of which the Country People want not their ſuperſtitious Traditions.

But to return to our Lake; I ſay, that about the Feaſt of St. *James's Tide*, and ſometimes not 'till *Auguſt*, the Water runs away, and it is dry: But it fills again, and moſt commonly in *October* or *November*, yet ſo as not to obſerve any certain time; for ſometimes it has been dry twice or thrice in a Year; as in the Year, 1685. it was dry in *January*. Again, the Water began to draw off on the 15th of *Auguſt*, *ſt. N.* and it was quite clear by the 8th of *September*; and this preſent Year, 1687. it has been thrice empty, which makes the Fiſhing very poor and inconſiderable. Sometimes again, tho' but ſeldom, it has happened to be three or four Years together full of Water, and then is the beſt of the Fiſhing. But it never yet was obſerved that this Lake was dry for a whole Year together.

The Right of Fiſhing in this Lake, upon certain Terms agreed on, does at this time belong to the Lordſhips or Caſtles following; 1. To *Haaſperg*. 2. *Steegberg*. 3. *Laas*. 4. *Schneeperg*. 5. *Aveſperg*. 6. *Sitticium*; which is a Monaſtery of *Ciſtertian* Monks.

There are 3 Iſlands in this Lake, *viz. Mala-goriza* and *Velka-goriza*, which are uninhabited: The third is a very pretty Iſland called *Vornek*, that is reaſonably big, having upon it a Village of four Houſes, called *Ottock*; above the Town upon a little Eminence ſtands a Church, which is no ſmall Ornament. Thoſe that live on it have Fields, Meadows, Paſtures, Wood, Gardens, and Orchards, and all Things neceſſary for Life.

There is alſo a very fine *Peninſula* all covered with Wood, called *Dorvaſek*. When the Lake is up, and one comes in a Boat between the Iſland *Vornek* and this *Peninſula*, the farther Part of the Lake, lying under the Mountain, very well reſembles a curious Port for Shipping. At the farther End, when the

Water draws off, there appear Rows of Stakes, a Sign that there hath been formerly a *Bridge*, and therefore it is at this Day called the *Old Bridge*.

In this Lake there are many Pits in the Shape of Baſons or Caldrons, which are not all of the ſame Depth or Breadth; the Breadth of them being from 20 to 60 Cubits more or leſs, and the Depth from 8 to 20 Cubits. In the Bottom of the Pits are ſeveral Holes, at which the Water and Fiſhes enter, when the Lake ebbs away.

The principal Pits, in which they fiſh, are 18, ſituated and named as is repreſented in the Map. They are called *Malijoberch*, *Velkjoberch*, *Kamine*, Fig. 60. *Sueiuſkajamma*, *Vodonos*, *Louretſchka*, *Kraloudour*, *Reſcheto*, *Ribeskajamma*, *Rethje*, *Sittarza*, *Lipanza*, *Gebno*, *Koteu*, *Ainz*, *Zeſlenza*, *Pounigk*, and *Leviſhe*. Beſides theſe there are ſeveral other leſs Pits of no Note, becauſe there is no ſuch fiſhing in them as in thoſe but now mentioned.

In the Months of *June*, *July*, and *Auguſt*, when this Lake begins to draw off, it grows quite dry in 25 Days, if no great Rains intervene. And the aforeſaid 18 Pits are all emptied, the one after the other, in a certain and never failing Order of Time.

When the Lake begins to ſink, which appears by a certain Stone that they obſerve, the Inhabitants of the Town called *Oberdorff*, or *Seedorf*, give notice thereof to all the neighbouring Fiſhermen, that are appointed by the ſeveral Lords having Right in this Fiſhing. The People of this Town have Orders not only to watch the falling away of the Water, but likewiſe to take care that no body preſume to fiſh in the Lake when it is full of Water; that being forbidden: So that theſe are, as it were, the Keepers of the Lake.

1. The firſt Pit, called *Malijoberch*, is not properly a Pit like a Caldron, but only a Depreſſion of the Bottom without any Holes in it: But there grows much Graſs and Weeds, and many Fiſh are catch'd therein. Three Days after the Water begins to ebb, this Pit is emptied: Then the Pariſh Clerk of *Seedorf* gives notice thereof by tolling a Bell, and all the Inhabitants of the Town, Old and Young, Men and Women, lay aſide all other Buſineſs and go to fiſhing, ſtark naked as ever they were born, without any regard to Modeſty or Shame.

The Fiſh they catch they divide in halves; one Part they give to the Prince of *Eckenberg*, as the Lord of the Manour, the other half is their own.

2. The Pit *Velkjoberch* is empty the third Day after *Malijoberch*; the Manner and Right of fiſhing as in that.

3. Four Hours after this the Pit *Kamine* begins to empty; here they generally fiſh with a Trawle, as in ſeveral other Pits of leſs Note, having firſt purchaſed leave of the aforeſaid Lord of the Manour. Here, as likewiſe in the Pit

4. *Sueiuskajamma* (which ſinks one Hour after *Kamine*) is much Fiſh caught, and Abundance of large *Crabs*; but they are lean, and of no good Taſte.

5. The fifth Pit *Vodonos* dries 5 Days after *Kamine*. In this and the other Pits which follow they fiſh with a long Net or Sayne. Herein they can have no more than five or ſix Hawls, by reaſon of the great Swiftneſs wherewith

the Water runs away at the Holes in the Bottom (which is ſuch that a Horſe can hardly keep Pace with it) and carries away the Fiſh with great Violence under the Earth. Sometimes, when Fiſhermen are not nimble, they can ſcarce get two Hawls before the Water be gone: To prevent which they have a Mark near this Pit, *viz.* the *Stone Ribeskekamen*, that is, *the Fiſher's Stone*; which, as ſoon as it begins to appear upon the Receſs of the Water, gives notice that it's time to begin the Fiſhing.

6. The Pit *Louretſchka* is evacuated a Day and a half after *Vodonòs*; the Fiſhing is after the ſame Manner, and the ſame Caution neceſſary, becauſe of the ſudden Receſs of the Water.

7. The Water leaves the Pit *Kraloudour* 12 Hours after *Louretſchka*; and three Days after that

8. The Pit *Reſcheto.* In this latter, in the Year 1685, after the Lake had been ſome Years without being dry, there were taken at the firſt Hawl 21 Carts of Fiſh, at the ſecond 17, and at the third 9; as I have been credibly informed by thoſe that were preſent.

9. The Pit *Ribeskajamma* falls dry at the ſame time with *Reſcheto*, which is that next to it. In this Pit they fiſh under Ground, which is a Curioſity not unpleaſant, and differing from all the reſt. For there is in the Bottom a great Hole in the *Stone*, by which Men may eaſily go down with lighted Torches, as into a deep Ciſtern; and there is under a large Cavern like a Vault, the Bottom or Pavement whereof is as it were a Sieve full of little Holes, whereby the *Water* runs away, leaving the *Fiſh* dry, where they are caught.

10. The Pit *Rethje* is empty two Hours after *Ribeskajamma*, and is of no great Conſequence for Fiſh. An Hour after this, the Pit

11. *Sittarza*; and in five or ſix Hours more

12. *Lipanza* falls dry.

13. The third Day after *Reſcheto* the Pit *Gebno* is evacuated; in this they rarely fiſh with Nets, but let fall dry; and the Holes in the Bottom being ſo ſmall, that they exceed not the Size of a Man's Arm, all the great Fiſh are left behind in the Pit.

14. Two Days after *Gebno* the Pit *Koteu* becomes dry: In this they ſometimes take the Fiſh as in the former; but the Holes being greater let bigger Fiſhes paſs.

15. The Pit *Ainz* empties four or five Hours after *Koteu*: In this they ſeldom (unleſs they cannot help it) let the Water run away without uſing their Nets, as in *Gebno*; becauſe of one great Hole in the Bottom, whereby many great Fiſhes may eſcape.

16. The Pit *Zeſlenza* ſinks three Hours after *Ainz*: In this they always fiſh with *Nets*; as in

17. *Pounigk*, which is emptied the next Day after *Koteu*.

18. The laſt Pit called *Leviſche* is evacuated the third Day after *Pounigk*, that is, the 25th Day from the beginning of the Receſs of the Water of the Lake; ſo that in 25 Days the fiſhing of this Lake is over. In this laſt Pit, about 17 Years ſince, I am certainly informed, that there fell a Flaſh of *Lightning* about the time of *Fiſhing*, which ſtunned a great Multitude of large

Fiſhes, ſo as that they filled 28 *Carts* with them: (By a *Cart* is meant as much as one Horſe can draw.) Theſe Fiſh are not properly *Thunder-ſtruck*, but only ſtunned with the Violence and ſulphurous Vapour of the Lightning, which makes them riſe and ſwim as dead upon the Top of the Water; but, if they be taken up and put in freſh Water, they ſoon recover, otherwiſe they die. This is no uncommon Accident in this Lake.

The Fiſhing being thus ended, a Sign is given by tolling the Bell in the Chapel of *St. John Baptiſt*, near the Town of *Cirknitz:* Upon which all the Inhabitants of the neighbouring Villages, and of *Cirknitz*, without regard either to Age or Sex, go for the moſt part ſtark naked into the Lake, and look for Fiſh among the Weeds and Sedge, and in the ſmaller Pits: And many creep into the ſubterraneous *Caverns* and Paſſages, and find Store of large Fiſhes there; they having full Liberty to ſearch all over the Lake, excepting in the Pits *Pianze*, *Narte*, and *Velkjoberch*. This barbarous and immodeſt Cuſtom of going naked has been often attempted to be reclaimed by the *Carthuſian* Monks, but all in vain; for ſo prevalent is a Habit of vicious Practices over good Precepts, that they have not yet been able to perſuade them ſo much as to cover their Secrets.

There are beſides theſe ſome other Pits in the Lake, as *Skednenza*, *Mala* and *Velka-bobnarza*, in which they fiſh likewiſe; as alſo in *Mala-karlouza* and *Velka-karlouza:* In both theſe they go far under Ground with lighted Torches, and find Fiſh; but theſe Pits are of no great Value. In *Velka-bobnarza* one may go in at great Holes, and deſcend many Fathoms under Ground. Theſe two Names *Velka* and *Mala-bobnarza* ſignify in the *Carniolan* Tongue the Greater and Leſſer *Drummer:* Nor is it without Reaſon that theſe Pits are ſo called; for, when it *thunders* and *lightens*, there is heard in theſe two Pits, as it were, the Sound of many Drums beating, which *Anno* 1685 I heard with my own Ears; it thundering three times ſucceſſively, and the Sound of Drums anſwering accordingly.

The two Pits *Narte* and *Pianze* are never emptied, but always remain *fenny*, when the reſt of the Lake is quite dry. It is believed that in theſe Pits the *Fiſh* lay their Spawn, and therefore it is prohibited to fiſh in them. In them is an incredible Number of *Horſe-leeches*, which, according to the vulgar Opinion, underſtand certain Words; for that, upon repeating them, they will come in great Parties towards him that repeats them; whereas, if he be ſilent, very few of them will touch him. Theſe *Horſe-leeches* often ſtick upon the People in the fiſhing time ſome of them being diſperſed all over the Lake;) and the Method they take to get them off is to get ſome other Perſon to piſs upon the *Leech*, which makes it let go its hold; and this, without any reſpect to Modeſty, is practiſed as well upon the *Women* as *Men*.

There are in the Mountain nigh the Lake, but ſomething higher than it, two great and terribly ſtony *Caves*, the one called *Urainajamma*, the other *Sekadulze*; which, tho' far diſtant one from the other, have yet the ſame effect, *viz.* When it *thunders* and *lightens*, theſe two *Caves* do emit *Water* with a wonderful and incredible Force, and with it ſometimes a great Quantity of *Ducks*, with ſome Fiſh; which I myſelf obſerved in *October*, 1685, not without great Danger of my Life. I took my Horſe and rid croſs the Lake as far as the Iſland *Vorneck*, in Company with two old experienc'd *Fiſhermen*; when ſuddenly the *Cavern* in the Mountain *Silvenza* began to breath forth miſty Vapours, forming a Cloud. Upon which my *Fiſhermen* adviſed me to make haſte, for without doubt thoſe Clouds would produce a *Tempeſt*. They had ſcarce ſaid ſo, when it began to lighten and thunder dreadfully; and I had Difficulty to perſuade them to accompany me as far as the Pit *Velkabobnarza*, being deſirous to examine what is ſaid of it; that, when it thunders, the *Sound* of many *Drummers* is heard in it. This I found 3 times to ſucceed as reported; and then, with all the Speed we could, we haſted to the Iſland *Velkagoriza*, not being able to go farther, becauſe the Water was in many Places grown out of our Depth, where two Hours before we had paſſed dry. Here we got one of the little *Fiſher-Boats*, which, when the *Lake* is dry, lie diſperſed here and there on the Bottom; and having got off my Horſe, we began our Voyage, but had the ill Luck to overſet our Boat, and ſo were obliged to ſwim for it, and with much to do arrived ſafe on the other *Shore*. Then we could ſee from the other Side, that the Water guſhed with great *Impetus* out of the Cave *Sekadulze*, being caſt 3 or 4 Fathom, as if it were forced by a *Fire-Engine*, and ſeveral blind *Ducks* were thrown out by the *Water*. It is not to be wondered that the *Lake* fills ſo faſt; for, conſidering the Violence wherewith the *Water* ruſhes, it is as much as a great *River*; this Cave *Sekadulze* being a Fathom wide, and higher than a Man. It is looked upon as a dangerous Thing to enter into this Cave, becauſe the Water comes ſo all on a ſudden, that if it ſhould chance to come it is impoſſible to eſcape it.

When it rains moderately, the *Water* ſpouts with great Violence two or three Fathoms perpendicularly, out of the Pits *Koteu* and *Zeſſenza*. It comes likewiſe forcibly out of the Spring *Treſenz*, as likewiſe out of *Velkjoberch*; bringing with it, at this latter, Abundance of *Fiſh*, and ſome *Ducks*. But when it rains very hard and long together, eſpecially with *Thunder*, then the *Water* breaks out with very great Force, not only from the aforeſaid *Pits*, *Holes*, and *Caves*, but likewiſe at ſeveral thouſand other little *Holes*, which are all over the Bottom of the *Lake*, and which, when the Lake is dry, drink up the *Waters* of the 8 Rivulets that run into it, ſpirting ſeveral Fathoms high, from ſome perpendicularly, from others obliquely, ſo that there is not a pleaſanter Sight than this. And out of the Pits *Vodonos*, *Reſcheto*, and ſome others, having got Holes at the *Bottom*, there comes with the *Water* a great Quantity of *Fiſh*. In caſe of great Rains, the 8 *Rivulets* are likewiſe much increaſed; ſo that, all things concurring, this *Lake* in 24 Hours Time will, from quite dry, be full of *Water*, and ſometimes in 18 Hours; tho' at other times it has been known to be three Weeks in filling. But it is a conſtant Obſervation, that *Thunder* and *Lightning* help much to fill it ſpeedily.

This Lake, being thus by turns wet and dry, ſerves the Inhabitants for many Purpoſes. For 1ſt, while it is full of *Water*, it draws to it ſeveral Sorts of *Wild-Geeſe*, and *Ducks*, and other *Water-Fowl*; as *Herons*, *Swans*, and the like; which may be ſhot, and are very good Meat.

Next, as ſoon as the Lake is emptied, they pluck up the *Ruſhes* and *Weeds*, which make excellent *Litter* for *Cattle*. 3. Twenty Days after it is fully dry they do cut a great Quantity of *Hay* upon it. 4. After the *Hay* is in, they plow it and ſow *Millet*, which ſometimes, by the too ſudden coming of the *Water*, is deſtroyed; but it generally comes to Maturity. 5. While the *Millet* is on the Ground, they catch a great Number of *Quails*. 6. The *Millet* being in, there is good Paſture for Cattle. 7. When the Lake is dry, there is great Variety of Hunting; there coming out of the neighbouring *Woods*, and *Mountains*, Plenty of *Hares*, *Foxes*, *Deers*, *Swine*, *Bear's*, *&c.* ſo ſoon as the Water is gone. 8. When it is full one may fiſh in it. 9. In *Winter-time* it will be ſo firmly frozen as to bear all Sorts of Carriages, and is a great Convenience to the People to fetch their Wood and other Neceſſaries. *Laſtly*, At the time when the Water goes away it yields great Abundance of Fiſh, as hath been already ſaid. And that which is moſt wonderful is, that all this comes to paſs in the ſame Place, and the ſame Year, provided the Lake be early dry, and it fill not too ſoon: But it is to be noted, that the Hay does not grow, nor is the *Millet* ſoon all over the Lake, but only in the more fertile Places.

There are only theſe Sorts of Fiſh taken in this Lake, which are very well taſted. They are the *Muſtela fluviatilis*, or *Eel-pout*, ſome of them weighing two or three Pounds. 2. *Tench*, ſome of them weighing ſix or ſeven Pounds. And *3dly*, *Pikes* in very great Plenty, 10, 20, 30, and ſome of 40 Pound Weight; in the Bellies of theſe it is common to find whole *Ducks*. *Crabs* are found no where but in the Pits *Kamine* and *Sueiuskajamma*: They are large, but ill taſted.

The *Cauſe* or rather *Modus* of all theſe wonderful *Phænomena* in the Lake of *Zirchnitz* is, according to my Opinion and Speculations, as followeth: There is under the *Bottom* of the *Lake* another ſubterraneous one, with which it communicates by the ſeveral *Holes* deſcribed. There are alſo one or more *Lakes* under the Mountain *Javornik*, but whoſe Surface is higher than that of the *Lake* of *Zirchnitz*. This upper *Lake* is poſſibly fed by ſome of thoſe many Rivers which in this Country bury themſelves under Ground, and has a Paſſage ſufficient to carry the *Waters* they ordinarily bring into it: But when it rains, eſpecially in *Thunder-Showers*, which are the moſt haſty, the Water is precipitated with great Violence down the ſteep Valleys, in which are the *Channels* of theſe *Rivulets*; ſo that the Water in this Lake, being increaſed by the ſudden coming of the Rains faſter than it can empty, ſwells preſently, and finding ſeveral Holes or Caverns in the *Mountain* higher than its ordinary Surface, it runs over by them both into the *ſubterraneous Lake*, under that of *Zirchnitz*, into which the *Water* comes up by the ſeveral *Holes* or *Pits* in the *Bottom* thereof, as likewiſe by viſible Paſſages above Ground, ſuch as *Urainajamma*, *Secadulze*, and *Treſenz*.

That ſome of theſe Paſſages bring *Fiſh*, ſome *Ducks* and *Fiſh*, others only *Water*, ſeems to depend on the *Poſition* of the inward Mouths of theſe *ſubterraneous Channels*; for, if they be ſo conſtituted as to draw off the *Water* from the Surface of the upper Lake on which the *Ducks* ſwim, they muſt needs be drawn away by the Stream into theſe *Caverns*, and come out with the *Water*: But if ſo that the *Channels* open into the upper *Lake* under the Surface of the *Water*, and from thence aſcend obliquely for ſome Space before they come to deſcend, then the Water they carry is drawn from below the Surface, and conſequently can bring with it no *Ducks*, but only *Fiſh*. Thoſe *Pits*, which yield only *Water*, may well be ſuppoſed to be fed by Paſſages too narrow to let the Fiſh paſs, tho' their Multitude may make the Quantity of Water they emit to be very conſiderable.

The Manner of the *falling away* of the *Water*, or *emptying* of the *Lake*, I thus explain. After a long Drought, or Want of *Rain*, all the Springs that feed the upper Lake under *Javornik* are much diminiſhed; ſo that, wanting freſh Supplies, it ceaſes to run over by the ſeveral Channels but now mentioned: Hence the Lake of *Zirchnitz*, and that under it, are fed only by the 8 Rivulets that always fall into them; and then the Water draws off faſter than it comes in, both by the Channels of *Mala* and *Velká-karlouza*, as alſo by a concealed ſubterraneous Paſſage out of the under Lake, which latter alone is able to tranſmit more Water than the ſaid 8 Rivulets afford. Conſequently the Lake muſt ſink, and that in a certain Proportion of Time, depending on the Quantity of Water to be evacuated, compared with the Exceſs of that that runs out, above that that enters at the ſame time, 1. Thoſe *Pits* that are higher are ſooneſt dry, the lower lateſt, and ſo come to be emptied in the Order above deſcribed; and, when the Lake is all dry, then the ſaid Rivulets ſoak by ſeveral little Holes in the *Bottom* into the under Lake, and all their Water is carried away by the aforeſaid *ſubterraneous Paſſage*.

That there is ſuch a *Paſſage* is very evident, and that it communicates under Ground with the Channels of *Mala* and *Velka-karlouza*, coming out with them, as hath been already ſaid, near St. *Cantian* at a Rocky *Cave*, and making the River *Jeſero*: For when the Lake of *Zirknitz* is very full, and runs out of both *Velka* and *Mala-karlouza*, the River *Jeſero* at St. *Cantian* overflows, and runs with great Violence; when it only runs out at *Mala-karlouza* (which is ſomewhat lower than the other) then the Water of *Jeſero* is much leſs rapid; but, when the Lake is ſo fallen that it runs out at neither of the two, the River *Jeſero* is ſtill leſs, but runs with a conſiderable Stream, 'till two Days after the Lake has been dry; after which the ſaid River becomes little, voiding no more Water than the Lake receives from the 8 Rivers that run into it: By which it is clearly proved, that this *ſubterraneous Paſſage* does meet with the Channels of *Velka* and *Mala-karlouza*, and needs no farther Illuſtration.

Hence it appears, why this Lake ſometimes is twice or thrice dry in a Year, at other times continues full for three or four Years together, but was never known to be dry for a whole Year's time; for it falls dry at any time, when there falls but little Rain in a long Space of time; and in rainy Years it continues always full; but it never happens in this Country that there is a Drought for a whole Year together.

The *Ducks* I have ſo often mentioned, and which are caſt out with the *Water*, are generated in the *Lake* under the Mountain *Javornik*; when they firſt come out they ſwim well, but are ſtark blind, and have no Feathers on them, or but few, and therefore are eaſily caught; but in 14 Days time they get *Feathers*, and recover their Sight yet ſooner, and afterwards fly away in Flocks. They are black, only white on the Forehead, their Bodies not big, reſembling ordinary *Wild-Ducks*, and are of a good Taſte, but too fat, having near as much Fat as Lean.

I killed ſome of them as ſoon as they had been caſt out at *Sekadulze*; and, opening their Bodies, I found in them much *Sand*, and in ſome few ſmall Fiſhes, in others green Stuff like Graſs or Herbs, which was the more ſtrange, becauſe I never found any green Thing growing in any of our *ſubterraneous Grottoes* or *Lakes* in *Carniola*; I tried alſo to procure ſome of the Fiſh at the time of their being caſt out, to open them, and ſee what they live upon; but notwithſtanding all my Endeavour, I could not get any of them to ſatisfy my Curioſity withal.

Almoſt every Year, at a Hole in the *Mountain* called *Storſeg*, about half a *German* Mile from the Lake of *Zirchnitz*, near the Town of *Laas*, whenever there happen great Floods of Rain, this Sort of *Ducks* is caſt out in great Abundance, by the Water guſhing out with much Force. I conceive that this *Cavern Storſeg* is another Paſſage out of the ſame Lake under *Javornik*, that overflows and fills up our Lake of *Zirchnitz*; but, this being ſomewhat higher, it never runs out, unleſs the ſaid *Lake* be more than ordinary ſwelled by the Violence of the Rains. The caſting out of great Numbers of *Ducks* here is ſo common, that it is looked upon as no Rarity.

It may ſeem ſtrange and hard to believe, that there ſhould be ſuch *ſubterraneous Lakes* and *Channels* as we may ſuppoſe; but, beſides that without them it would be impoſſible to account for all theſe ſeveral Effects, which are moſt true, and which I myſelf have obſerved, there is a moſt notable Inſtance of the like Things found in the *ſubterraneous Cavern*, called the *Grotto Podpetſchio*.

Fig. 3. This *Grotto* is in *Carniola*, in the Pariſh of *Guetenfeld*, diſtant four *German* Miles from the City *Labac*; *a* is a Hole or Entrance into the rocky Mountain; *b* is a great *Cavern* in the Mountain, capable to hold above a hundred Horſemen; *i k* is a Channel big enough for a Man to paſs by as far as the Lake *o*, out of which Lake the Inhabitants hereabouts draw all their Water, having none nearer, and fetch it with lighted Torches. Into this Lake *o* the Water runs with a great Stream by the *Channel l*, and out of this Lake it falls down a Precipice into a great Cavern, with ſo much Noiſe, that the Diſcharge of a Piſtol would not be heard here. There is likewiſe another Channel *m*, which tends upwards obliquely, and leads to the great Lake *n*, whoſe Length and Breadth are hitherto undiſcovered; I looked about it with many Lights, and could ſee nothing but Water; and, throwing Stones ſeveral Ways as far as I could, I heard them all fall in the Water: And I found the Depth of it near the Bank to be ten Cubits, and doubt not but it is much deeper in the Middle.

The Country People told me, that this Channel *l* affords always an equal Quantity of Water, or elſe is quite dry; and that ſometimes it will ceaſe to run in a Moment, and continue dry for ſome Weeks; and then on a ſudden it will run again with great Force, ſo as the Noiſe thereof frequently frights the People as they come for Water.

Out of the Cave *b* there is another Channel *c*, which is divided into three others *d e f*. This Channel *f* tends obliquely downwards, 'till it comes to a running Water in *g*, from whence one may go on to *h*, where, looking thro' a little Hole, one may ſee another little Lake.

All the Channels I have mentioned are formed in a very hard Rock, and are ſmooth or poliſhed, as if cut by Men's Hands. Theſe may be ſeen by any one that will go with lighted Torches; and there are many ſuch, in which I have not been.

If any one would carry a Boat to the Lake *n*, and would row upon it, I doubt not but he might find ſeveral curious Things. I believe this *ſubterraneous Lake* to be a *German* Mile long: For from this *Grotto Podpetſchio*, at a Mile's Diſtance, there is a Village called *Kompale*, whoſe Inhabitants have no other Water than what they fetch out of a Hole in the Rock, going with lighted Torches, by a large Channel, to a great Lake under Ground. I meaſured with good Geometrical Inſtruments, ſuch as Miners uſe, the Level of theſe two Lakes of *Podpetſchio* and *Kompale*, and found them to be in one *Horizon*; and this I did twice, both when the Channel *l* at *Podpetſchio* run, and when it did not run. When it began to run, I found, that the Lake *n* was two Cubits higher than it had been before; when it ceaſed to run, I came again on purpoſe to obſerve it, and found that then alſo the other Lake at *Kompale* was in the ſame Level; from whence it is moſt certain, that theſe two are only one continued *ſubterranean Lake*.

The Lake of Geneva; *by* * * * n.86.p.5043

XX. The Lake of *Geneva*, which is one of the moſt pleaſant Places of the World, lies like a *Croiſſant* of Water, one Extremity whereof is 18 Leagues diſtant from the other, and the Banks of which are gently raiſed to ſome Heights, then to Collines, at length to ſtupendious Mountains; which yet are not ſo linked to one another, but that they leave betwixt them Interſtices of 15 or 20 Leagues Proſpects, checkered by Meadows, Corn-Fields, Orchards, Vines, Foreſts of Fir-Trees, Snow lying on the Sides of the Rocks. All thoſe Objects, which at a Diſtance are confounded, and ſeem to make but one, have near hand their ſeveral Beauties. That Point, where *Geneva* ſtands, is ſomewhat longer and more extended than the other. This *Croiſſant*, where 'tis largeſt, which is from *Morges* to *Thonon*, is about 5 good Leagues over.

The Water of this Lake is very good to drink, and ſo limpid alſo, that even in the rolling of the Waves, which ſometimes go high enough, the Water is not troubled but along the Banks. And if one do attentively look down from the Caſtle of *Chilon*, or from any of the neighbouring Heights, into the Bottom of the Lake, he may ſee high Mountains under the Water. And the Water is ſo deep before *Veuvay*, that the ſounding Line at the End of 400 *Fathoms* ſeems, becauſe it will not ſtay, to touch upon ſomething ſlippery. 'Tis held to be 500 *Fathoms* deep before *Rolle*; and 'tis affirm'd, that near this great Depth there may be ſeen a kind of Iſle under Water.

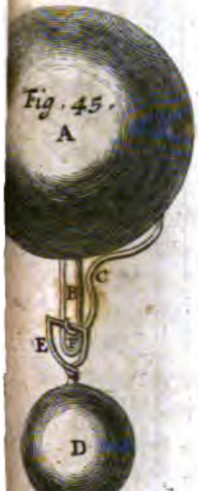
The *Rhone* enters at one of the Points of the *Croiſſant* into the Lake, and iſſues out at the other; but with this Difference, that whereas he comes in dirty and miry, he ever goes out ſo pure and clear, that under the Bridge of *Geneva*, where the Water is deep 25 Feet in Summer, you may well diſcern the ſmalleſt Stones at the Bottom. And the ſame Water, which in this Place appears of a *Sapphyrine Blew* in the Shade of the Houſes, appears altogether *Green*, nor is ſo tranſparent, when the Sun ſhines on it.

Having heard the Sentiments of the Curious of *Lauſanne* and *Geneva*, and the Opinions of the moſt knowing Fiſhermen, that are there in great Number, and eſpecially at *Coupet*, I believe with the latter; that although the *Rhone* entering into the Lake loſeth its Violence, yet doth he ſtill keep ſome ſenſible Motion in ſome Places, and every where obſervable; and that no *Trouts* are taken any where in this Lake but in this *Current* of the *Rhone*.

The Water of this Lake commonly begins to encreaſe about the End of *January*, or the Beginning of *February*, and continues to do ſo unto the 20th of *July*, and often unto the very Month of *Auguſt*; and then it inſenſibly decreaſeth, ſo that the Water is leſs high in the Winter than Summer, by 12 or 15 Feet. About this Increaſe of the Water there are different Opinions; 'tis true, they all believe in general, that the principal Cauſe of the Increaſe of the Water is the melting of the Snow, and of the Mountainous Ice, that is in the Winter formed of the Waters of the Springs, and Torrents, which the Froſt fixeth. This is ſo true, that, when there is much Snow in Winter, the Waters are very high the enſuing Summer: But when great Rains chance to fall in *January*, then the Snow, not yet being well harden'd, melteth on a ſudden altogether: And, when this Melting is not ſo violent, all the Snow, that will melt, melts at the End of *May*, or the Beginning of *June*; ſo that, there remaining but the Stock of Ice for entertaining the Increaſe of the Water unto the Month of *Auguſt*, ſome have thence been induced to aſſign other Cauſes.

At the Iſſuing out of the Bars, that from *Geneva* on the Side of the Lake, are ſeen in the Water two or three huge Flints ſtanding out of the Water, the chief of which they call *Niton*: And the Tradition is, that it formerly was an Altar conſecrated to *Neptune*, there being alſo a Place cut out in the Middle, which they take to have been the Place for the Sacrifice. On this Flint 7 or 8 Perſons can ſit; and ſometimes, when the Waters are very low, there are found about it Knives, and Needles, as thick as Bodkins of Tweezers, and much longer; both of Braſs, well enough made, and eſteemed for to have ſerved for the Sacrifices.

This Lake in ſerene and calm Weather appears ſometimes, and that even before Sun-riſing, as if it were made of diverſe Pieces differently coloured; part of it being browner than the reſt; which ſeems to be cauſed by a Breath of Wind paſſing thorow the Water, coming either from the Bottom of the Lake, or from above; though others think this gentle Agitation



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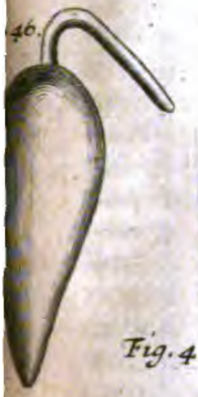

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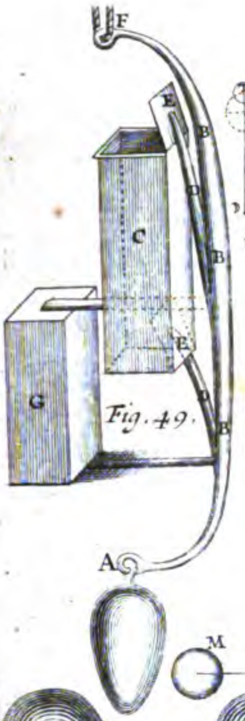

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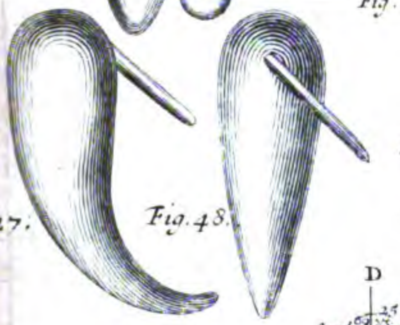

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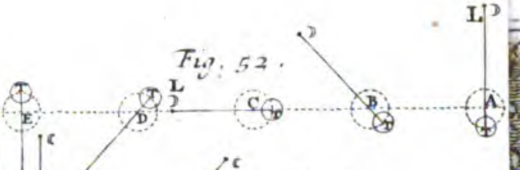

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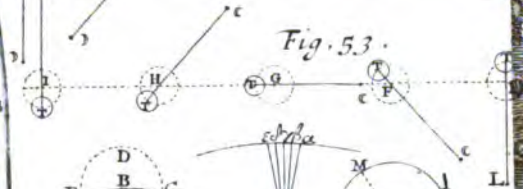

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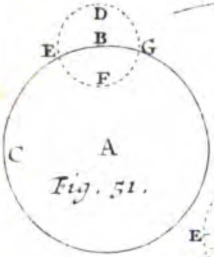

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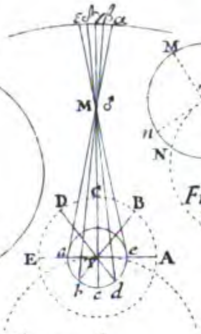

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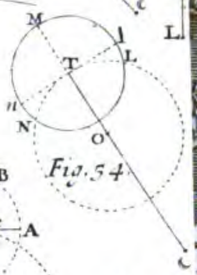

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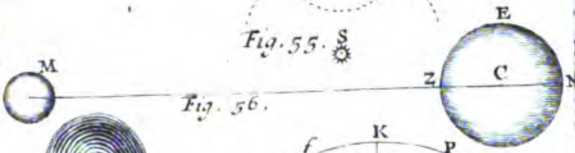

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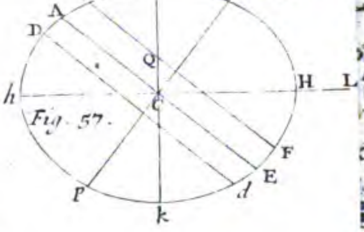

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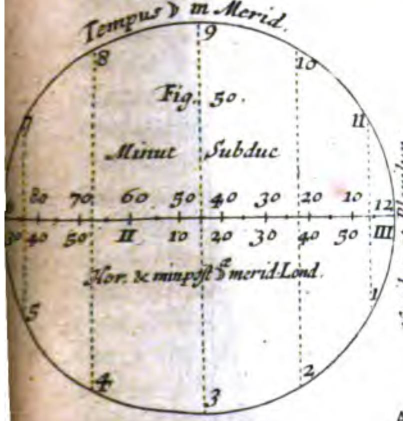

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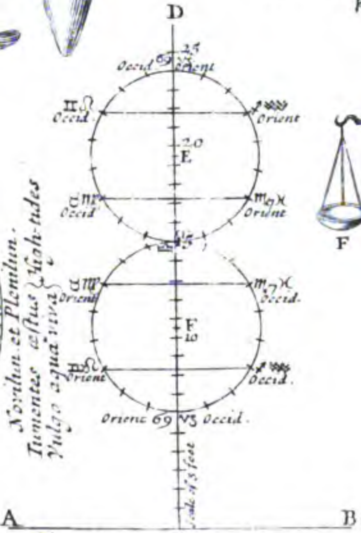

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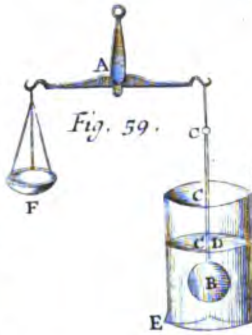

Fig. 59.

tation to proceed from ſome Springs that are at the Bottom, making the Water ſhiver above. But that Part of the Water, that is not moved, appears as even and ſmooth as a Looking-Glaſs, or like Water traced by a Ship. And, as for the Colours, they are, in my Opinion, an Effect of the neighbouring Mountains; the different Images of which, being confounded in the Water, make an Appearance of very pale Colours.

After that the *Rhone* is entered into the Lake, he retakes not his impetuous Courſe before a Quarter of a Mile's Diſtance from its coming forth again, that is, above *Geneva*. And the nearer he comes to that Town, the more his Bed becomes narrow, and conſequently his Courſe more rapid. Yet this Rapidneſs hath been in our times once ſurmounted by Wind, and once by Water.

In the Winter of the Year 1645. there aroſe in the Morning, about nine o'Clock, ſo furious a Wind, that not only it uncovered the Houſe, but alſo laid dry the Bed of the *Rhone* above the Bridge; ſo that many, in the View of all the Town, croſſed quite over it (to the little Iſland) dry on Foot, and one of the Sons of M. *D'Aubigny* took up ſome Medals, which he found in his way. This Paſſage was free during an Hour's time, at the End of which the River retook its Courſe. At that Seaſon the Water being very low, and a Weſt-Wind to arrive at *Geneva*, being preſſed by the high Mountains, that bring it upon the Town as by the Noſe of a Pair of Bellows, it came to paſs, that the Wind did violently bear upon the Water near the Bars, keeping ſuſpended the Water that was beyond, and thoſe Waters that were beneath running away downwards by a Declivity, and under the Shelter of the Houſes. Whilſt I was ſcrupling at this Relation, they brought me *Gallaſius* his Commentary upon *Exodus*, printed 1560; where 'tis recorded, that the like Accident had fallen out at *Geneva*, at the time when that Miniſter lived there; a South-Weſt Wind having made the *Rhone* to recoil into the Lake, and many People having thereupon paſſed over dry for an Hour's time.

Concerning the other Accident; you may remember that the River *Arve*, which is a kind of Torrent, falls into the *Rhone*, about 1000 Paces beneath *Geneva*. In the Month of *December*, in the Year 1652, the ſaid *Arve* did ſo extraordinarily ſwell, that not only it over-run its Banks with Impetuoſity, but alſo interrupted the Courſe of the *Rhone*, aud forced it to re-enter into the Lake for the Space of 14 Hours.

This Lake doth very much abound with Fiſh, which have, as it were, cantoniz'd themſelves, and divided the Lake amongſt them. The Trouts are not to be found there, but, as hath been already mentioned, in the Current of the *Rhone*, the *Carps* have taken up their Quarters towards *Vevay*; the *Pikes* and *Pearches* have alſo their Habitations a-part: But ſome other Fiſh, that are but Paſſengers, not living conſtantly in the Lake, ſpread themſelves almoſt every where indifferently. The great *Trouts* paſs out of the Lake for 4 Months of the Summer, and are taken in Autumn when they are returning thither. The Fiſhing is farmed out at *Geneva*; and there are Conſervatories, where many of theſe big *Trouts* are kept; among which there are ſome that weigh Fifty Pounds. Sometimes they catch *Pikes* there of 80 Pounds Weight; and a Pound Weight at *Geneva* you know to be 18 Ounces.

In the Months of *July* and *Auguſt* they fiſh for the Fry of *Pearches*, at a Time when they are no bigger than the ſmalleſt Taggs. Theſe are a very delicious Diſh, there called *Mille Cantons*.

The Lake A-vernus; By Dr. Tancred Robinſon, n. 172. p. 1038.

XXI. I have ſeen many Water-Fowl feeding upon and flying over the Lake *Avernus*, reported by many of our own, as well as foreign Writers, to kill Birds at a Diſtance. I obſerved ſeveral Land-Fowl alſo to fly over that Lake, without the leaſt Diſturbance, from all Sides and Ends. But peradventure the poiſonous Steams (if there are any peculiar to that Lake) ſometimes vaniſh and return again; or elſe may be alter'd by new *Effluviums* intermingled with them.

The Lake of Mexico; *By* * * * * n, 130. p. 758

XXII. The Lake of *Mexico* hath this of extraordinary, and perhaps peculiar, that Part of its Water is ſweet, and the other Part ſalt; which makes it believed to be derived from two Sources, whereof the one holds ſweet Water, the other comes from ſome Mineral and *Saline* Earth found in the Hills through which this *Water* paſſeth, and is impregnated with the Salt which is diſſolved in its Courſe: Or, if it have no peculiar Source, it muſt be, that that, which makes Part of the Lake *ſalt*, is the *Bottom* of the *Earth* under the *Water*, being in that Place full of *Salt*; which is confirmed by Experience, much *Salt* being made of it every Day, of which that City drives a great Trade with remote Parts, even the *Philippines* themſelves, whither it is tranſported in conſiderable Quantities. That Part of the Lake, which is ſweet, is ſtill and quiet; the *ſalt* Part is agitated and moved according as the Winds blow. The ſweet Water is very good and wholeſome, breeding Plenty of little Fiſhes; that, which is moved, is *bitter Salt*, breeding no Fiſh at all. The *ſweet Water* is higher than the other and falls into it. The *Water* of the *ſalt* Part is 7 Leagues long, and as many Leagues broad, and hath above 22 Leagues in Compaſs; that of the *ſweet Water* is near as big; and the whole Lake contains about 50 Leagues in Compaſs.

An Inland Sea near Dantzick, *yielding in Summer a* poiſonous Subſtance; *By Mr.* Kirkby, n. 83. p. 4096

XXIII. Near a ſmall Village call'd *Tuckum*, 2½ *German* Miles diſtant from *Dantzick* Weſtward, there is an *Inland-Sea* (made by the meeting of 3 Rivulets, ſome Springs from the adjoining Hillocks, and the deſcending Rain and Snow-Water) of about half a *German* Mile long, and an eighth Part of ſuch a Mile broad. The Soil of the Ground round about ſeems to be Sand mixed with Clay. Its Shore generally ſandy, as is its *Bottom* alſo; its Depth, where deepeſt, four Fathoms; but for the moſt Part but one, or one Fathom and a half. 'Tis ſtored with wholeſome and delicate Fiſh, as *Pearch*, *Roach*, *Eels*, *&c.* and famed for a ſmall Fiſh much eſteemed here, and not much unlike a *Pearch*, only not ſo party-coloured, and having a larger Head proportionable to its Body, called the *Coal-pearch*. The *Water* is *ſweet* and *wholeſome*; but only in the *three* Summer *Months*, *June*, *July*, and

Auguſt, it becomes every Year, during the dry Weather, Green in the Middle with an *hairy Effloreſcence*; which *green Subſtance*, being by ſome violent Wind forced aſhore, and with the Water drunk by any Cattle, Dog, or Poultry, cauſeth certain and ſudden Death; whereas at the ſame Time, that a knowing and ingenious Perſon (who firſt acquainted me with it,) ſaw three Dogs killed with it, the Horſes that were ridden into the *Water* beyond the Place, where this *green Subſtance* floated, drunk without any hurt; and that alſo, during the ſame Seaſon, the *Water* in the Streams, that flow from it, are *wholeſome*.

Some extraordinary Lakes in Scotland; *By Sir Geo.* Mackenzy. n. 114. p. 307

XXIV. 1. There is a little Lake in *Straberrick* on the Lord *Lovel*'s Lands, which never freezes all over (even in the moſt vehement Froſts) before *February*; but one Night's Froſt thereafter will freeze it all over, and two Nights then will make the Ice of a very conſiderable Thickneſs. I have heard of two other Lakes, one of which, is on Lands belonging to myſelf, called *Loch Monar*, of a pretty Largeneſs, which ſteddily keeps the ſame Method. There is another little Lake in *Straglaſh* at *Glencanich* on Lands belonging to one *Chiſſolm*, the Lake lies in a Bottom 'twixt the Tops of a very high Hill, ſo that the Bottom itſelf is very high. This Lake never wants Ice on it in the Middle, even in the hotteſt Summer, though it thaws near the Edges: And this Ice is found on it, though the Sun, by the Reaſon of the Reflection from the Hills, in that Country is very hot; and Lakes lying as high in the Neighbourhood have no ſuch Phænomenon. 'Tis obſervable alſo, that about the Borders of this Lake the Graſs keeps a continual *Verdure*, as if it were in a conſtant Spring, and feeds and fattens Beaſts more in a Week than any other Graſs doth in a Fortnight.

Our famous Lake *Neſs* never freezes; but, on the contrary, in the violenteſt Froſts, the greater Clouds of Steams do ariſe from it. And I remember, that at two ſeveral Times, I being at *Inverneſs*, walking in the Evenings along the Bridge over the River *Neſs*, a Miſt of thoſe Steams coming from the Lake and falling down to us over the River (for there was no Miſt in any Place thereabout but on this Lake and River only) our Hair became all white, like the Whiteneſs of a Hoar-Froſt, but it was ſoft and warm; and this was in the midſt of Summer and in warm Evenings. Doctor *George Mackenzy* (who lives at *Inverneſs*) told me, that he obſerves *Roſemary*, though uncovered, to continue in the Gardens about that Lake's Side, notwithſtanding the laſt Winter's long and violent Froſts; whereas a far leſs violent Winter ordinary kills all the *Roſemary* which is in Gardens that lie in warmer Places, and at the Sea-ſide: And though I live near it, and in a better Soil and warmer Situation, yet any *Winter*, more than ordinary cold, kills my *Roſemary*, though covered over with *Straw* and *Litter*. This he attributes (and I think on good Ground) to the Warmth occaſioned by thoſe *Steams* that frequently ariſe from that *Lake*.

In *Glevely*, at a Place called *Achigniglium*, there is a little Rivulet, which ſo turns *Holly* into a *greeniſh Stone*, that they ordinarily make Moulds of it for caſting of Balls for Fuzees, and Tinkers that work in Braſs make both their

Moulds and melting Pots of it, and *Women* their round Wharls for ſpinning. May it not be, that by the long Infuſion in *Water*, deſcending from Hills, which perhaps abound in Marle, capable to be diſſolved into ſmall Particles by the conſtant waſhing of the *Water*; may it not be, I ſay, that theſe little Particles do intrude into the cleanſed Pores of the *Holly*, and ſo make up that ſoft *Stone*? And any thing ligneous remaining of the very hard Timber, being all incruſtated with this Marle, may it not thereby be guarded from the Action of the Fire?

By Mr. Ja. Fraſer, n.254.p.230 2. The Lake *Neſs*, according to Highland Tradition and Bards, has its Name from one *Nyſus* an *Iriſh Hero*, that fix'd a Colony in *Stràtharig*, with *Dornadillo* his Wife. The Promontory, upon which he had his Reſidence, is to this Day called *Doun Dearnill*; and he being the firſt that ever offered to ſet out Boat or Barges upon this Lake, it is after him called *Loch-Neſs*. It is 24 Miles in Length, and in moſt Places two in Breadth. One *George Scot*, tried 500 Fathoms, and Capt. *Orton* a whole Barrel of Plum-line; but found no *Bottom*. The Banks of this Lake aſcend high and mountainous, with *Woods*. The Lake never freezes, which is imputed to the many great Springs and Fountains in it; the only Fiſh in it is *Salmon*. This Lake *Neſs* diſcharges itſelf in a River of the ſame Name, ſix Miles in Length, which runs ſlowly, yet never freezes, but ſtill ſmoaks with Froſt: And from this Smoak is ſpread a Fog over all the adjacent Country.

On the Side of *Loch-Neſs* ſtands the famous Caſtle of *Urqhart* upon a Rock; the great Ditch round it was for the moſt Part cut out of the Rock, and received the *Water* of the Lake. This Caſtle conſiſted of ſeven great Towers, and 'tis ſaid was built by the *Cuminees*, but had its Overthrow by King *Edward* the firſt of *England*; and nothing remains now but one Tower to the Eaſt.

To the *Weſtward* of this Caſtle about four Miles, upon the Side of *Loch-Neſs*, ſtands that great Mountain *Meal fuor vouny*, of a round, neat, high Shape; it will be two Miles of perpendicular Height from the Lake. Upon the very Top of this Hill there is a Lake of cold freſh Water, about 30 Fathoms in Length and ſix Broad, no Courſe or Stream running to it or from it. I plum'd with 100 Fathom of ſmall Line but could find no Bottom. It is always equally full, and never freezes.

About 23 Miles Weſt from the End of the River of *Neſs*, there is a Foreſt called *Affaruck*, in which there is a Mountain called *Glenin-tea*; and on the North-ſide, under the Shade of a great ſloping Rock, ſtands a Lake of freſh Water, called *Lochan-Wyn*, or *Green-Lake*, 18 Foot in Diameter, about a Fathom deep. This Lake is always covered with Ice, Summer and Winter.

Lough Neagh *in* Ireland; *by* Mr. Will. Molyneux. n.158.p.552 XXX. 1. It is generally agreed by all the Inhabitants thereabouts that *Lough-Neagh* has a petrifying Quality: But that no Wood will petrify in it except *Holly*. It is alſo aſſerted with ſome Probability, that the Earth about the *Lough* has this petrifying Quality: For I am certainly informed, that a Gentleman of the County about this *Lough*, a little before the Rebellion, cut down ſome Timber for building, and amongſt others cut down a large *Holly* Tree, but being diverted by the Rebellion from building, his Timber lay on the Ground in the Place where it was fell'd, upon the Banks of the *Lough*, all the miſerable Time of the War, 'till at laſt the Kingdom being ſettled, the Gentleman went to look for his Timber, and found the other Timber overgrown with Moſs, and the *Holly* petrified, tho' the Water of the *Lough* had never reached it.

And perhaps the *Holly* itſelf, that grows upon the Banks of this *Lough*, may be more apt to be petrified, than the ſame Wood growing other where, and brought thither, and put into the *Lough*; for certainly if the Ground has this Quality, this is very likely to follow.

That what we call *Lough Neagh Stone*, was once *Wood*, is moſt probable on theſe Accounts. *Firſt*, It will not ſtir with *Acids*. 2. It will burn and flame, and the Smoak of it ſmells like the Smoak of Wood. 3. When burnt it betrays the very Grain of Wood with the other Veſſels belonging to *Vegetables*. 4. I have many of them of various Degrees of *Petrification*, ſome that have clearly loſt the Colour of Wood, and are become perfectly black, and very hard; others, that are not ſo black nor hard; but one more eſpecially was ſent me about a Year ago, which is a Parallelopiped of about 4 Inches long, and an Inch thick; cut, I ſuppoſe, whilſt Wood, in that Shape purpoſely, whoſe outward Coat is very black, and ſmooth; but this is merely ſuperficial, for being cleft longwiſe through the Middle, (which it ſuffered far more eaſily than that which is more throughly petrified) I there diſcovered the whole Body perfectly of the Colour and Grain of *Holly*, for I can ſcrape it with my Nail; but what was moſt ſurprizing in it was, the Diſcovery of the *Pith*, as plainly and as perfectly diſtinct in Colour and Texture from the reſt (but it alſo was petrified) as it could poſſibly have been ſeen in the natural Wood.

I never have ſeen nor could hear of any Part of the Stone in the leaſt reſembling Iron.

I have uſed ſome Endeavours to procure a Piece of this *Lough Neagh Stone* to which the Wood was yet faſtened, but I never could attain it, tho' ſome aſſert they have ſeen Pieces two or three Foot long, with about eight or ten Inches of *Stone*, and the reſt Wood. Tho' I am apt to believe this may be ſtretching the Matter too far, for I conceive that that Humour that petrifies one Part, when it begins to operate, inſinuates itſelf ſoon throughout the whole Body.

'Tis obſerved that this petrifying Quality is not equally diffuſed throughout the whole *Lough* (which is about 15 or 16 Miles long, and 8 or 9 Miles broad in all Places) but is moſt ſtrong about that Part where the *Black Water* (a River ſo called) empties itſelf into this *Lough*, that is about the South Weſt Corner; as likewiſe it is ſaid to be more ſtrange about the Edges of the *Lough*, than farther into the *Water*.

I have found upon Trial, that this Stone is not *Magnetical*, for it will not n.166.p.820 ſtir a *Needle*, or *Steel-filings*, neither will it apply to the *Magnet*, in *Powder* or *Calcined*.

Upon farther Trial I find, that though it will not apply to the *Magnet Crude*, yet being *Calcined* it applies moſt briſkly: The occaſion of my former Error being, that I did not *Calcine* it long enough.

By Mr. Edward Smith, n. 174. p. 1108.

2. No Experiment, or Obſervation yet made, (that I can hear of) can prove that this *Lough* has really the Quality of petrifying Wood; or that the *Water* does any way help or promote the Petrification. On the contrary, a neighbouring Gentleman of good Credit and Worth, about 19 Years ago, ſtuck two *Holly Stakes* (a *Wood* which all agree will ſooneſt petrify in this *Lough*) in two ſeveral Places of the *Lough*, near that Place where the upper Band enters into it; and that Part of the Stake, which for ſo long Time has been waſhed by the *Water*, remains there without any Alteration, or the leaſt Advance towards Petrification. It is reported indeed that the *Water* has this Virtue, eſpecially about thoſe Places, where the *Black Water* diſcharges itſelf into the Lake: But it ſeems evident from the very Nature of liquid Bodies, that any Virtue received in one Part muſt neceſſarily be diffuſed through the whole, at leaſt in ſome Degree; and therefore there is good Reaſon to believe, that the *Water* is wholly deſtitute of this petrifying Quality.

But that this Virtue is certainly, if not only, in the Ground or Soil, I judge for theſe Reaſons; that there are many *Stones* turned up daily, eſpecially at their breaking up new Ground, which we cannot in any Probability think were brought thither: They are often found at two Miles Diſtance from the *Lough*, ſeldom farther, in great Numbers, and very deep in the Ground; and a Gentleman (on whoſe Credit I received the Information) ſaw a Stump of a *Tree* digged out of the *Ground* at a ſmall Diſtance from the *Lough*, which by handling of it he found to be petrify'd: He aſſured me the Roots and all were Stone, and altogether like thoſe Stones that are ordinarily found, and go by the Name of *Lough-Neagh Stones*. This Gentleman was of Opinion theſe were *Lapides ſui generis*, 'till this Obſervation convinced him. And that theſe *Stones* were once Wood, is, I think, very certain, for they ſhew the plain *Veſtigia* of Wood; they likewiſe *burn*, *cleave*; *Filings* of this *Stone* thrown into the Fire emit a *fragrant Smell*; and they cut kindly with a Knife, though not ſo eaſily as other Wood.

That not only *Holly*, but alſo other *Wood* has been *petrified* about this *Lough*, and in the *Soil* adjacent, I have ſufficient Grounds to conjecture on this Account; becauſe ſome Fiſhermen, being Tenants of a Gentleman from whom I had this Relation, told him, they had found buried in the *Mud* of this *Lough* great *Trees*, with all their *Roots* and *Branches petrified*; and ſome of that Bigneſs, that they believed they could ſcarcely be drawn by a Team of Oxen. They broke off ſeveral Branches as big as a Man's Leg, and many bigger, but could not move the great Trunk. By this Bulk of it, I gueſs it to be *Oak*, no Trees in that Country, theſe excepted, growing to that prodigious Bigneſs; at leaſt 'tis certain that *Holly* never grows to that Bigneſs.

Two Gentlemen of the *North* told me, that they themſelves had ſeen the ſame Body *partly Wood* and *partly Stone*: But the only Reaſon for thinking ſo, being the Diverſity of Colours, which might well enough proceed from ſeveral Degrees of Petrification, we may properly think them deceived; for they made no *Experiments* on that Part which they reputed *Wood.*

The *Bark* is never found petrified; as I am informed by a diligent Inquirer, but often ſomething rotten about the Stone anſwerable to the Bark.

XXVI. A Gentleman tells me, that he hath met with a Place in *England*, where, tho' there be no *petrifying Spring*, (for that I particularly asked) *Wood* is turned into *Stone* in the ſandy Earth itſelf, after a better Manner than by any *Water* I have yet ſeen. I find it to be a very odd Subſtance, wonderfully hard and fixed. Here is a certain Stone, that is thought to be *petrify'd Bone*, being in Shape like a *Bone*, with the *Marrow* taken out; but with a fit *Menſtruum*, I found that I could eaſily diſſolve it, like other ſoft Stones. And poſſibly it may prove as fit as *Oſteocolla*, for the ſame medicinal Uſes.

Petrification, *by Mr.* Rob. Boyle, n. 6. p. 101.

XXVII. From the *But* of a growing Elm near *Wadley* (a Mile from *Farrington* in *Berks*) one of the ſpreading Claws having been formerly cut off with an Axe, that Part of the *But* from whence the ſame was ſevered, being about 1 ½ Foot above Ground, and inward within the Trunk of the Tree, hath contracted a petrify'd Cruſt, about the Thickneſs of a Shilling all over the *woody Part* within the *Bark*; the Marks of the Axe alſo remaining very conſpicuous, with this petrify'd Cruſt upon it.

By Mr. Ph. Packer, n. 19. p. 329.

XXVIII. We have ſome Waters in *Scotland* that *petrify*. Upon the North Side of the *Firth* of *Forth*, ſome 8 Miles from the City, there is a Cove cloſe upon the Sea, the Roof of which is covered with a *Stalagmites* a Foot deep, like the Fringe of a Bed; the upper Coat is of a Sea-colour, the Juice is as white as the *Sal Prunellæ*; the Water which droppeth from it, if it touch the Skin, maketh it ſmart. Near to this ſame Cove, is a Piece of an hollow Rock, which within, from the Top to the Bottom, is full of ſo many Orders of Columns, reſembling the Pipes of a Church Organ, and ſome of different Figures, I broke a ſmall one and found it ſomewhat hollow in the Middle. All the Ground in this Place is full of *Lime-ſtone.*

Petrifying Waters *in* Scotland, *by* Sir Rob. Sibbald, n. 222. p. 321.

XXIX. As I travelled over *Stanemore* in *Yorkſhire*, I obſerved the River *Greatab*, (a River about half as big as *Charwel* at *Oxford*) run under Ground for about a Mile, ſo that we paſſed over it dry Foot. The Paſſage under Ground is but narrow; ſo that in Winter when the Streams are high, it keeps the Channel above Ground.

The River Greatah *running under Ground, by Mr.* Hugh Todd, n. 163. p. 729.

XXX. At ſome Leagues Diſtance from *Gottenburgh* in *Sweden*, that River ruſhes down from a prodigious high *Precipice* into a deep *Pit* with a terrible Noiſe, and ſuch a mighty Force, that the Maſts (which are floated down this River to *Gottenburgh*) uſually turn topſy-turvy in their Fall, and do often fly to Pieces when daſhed againſt the Surface of the *Water* in the Pit. This occurs if the *Maſt* falls ſide-ways upon the *Water*: But if they fall end ways, they dive ſo far under Water, that (according to my Information, they riſe not again

A Contract *in* Gottenburgh *River by Mr.* Gourdon, n. 260. p. 693.

again for $\frac{1}{4}$ Hour; others $\frac{1}{2}$ Hour; ſeveral $\frac{3}{4}$ of an Hour; and ſome a whole Hour and upwards. The *Lake* or *Pit* into which they fall has been often ſounded with a Line of ſome hundred Fathoms long, but never could they find any Ground.

River Water [illegible] ſtinking, [illegible] 187. p. 652.

XXXI. Tho' it be commonly reputed peculiar to the *Thames Water* alone, upon ſtinking, to be recoverable or portable again; I can affirm, upon my own Knowledge, that Water taken a-board at *New-London* in *New-England*, tho' in 8 Days time it ſtunk intolerably, yet when we came to *Virginia*, it recovered ſo perfectly, that I made no ſcruple to drink of it in Harbour, even when we had freſh Water newly brought from Shore; nor could I eaſily perceive it had any Relicts of its late Corruption.

Inundations in Gaſcoyne, by M. Ph. Col. n. 1. p. 9.

XXXII. 1. In the Beginning of *July* 1678, after ſome gentle rainy Days, which had not ſwelled the Waters of the *Garonne* more than uſual, one Night this River ſwelled all at once ſo mightily, that all the Bridges and Mills above *Toloufe* were carried away by it. In the *Plains* which were below this Town, the Inhabitants who had built in Places which by long Experience they had found ſafe enough from any former Inundations, were by this ſurpriz'd, ſome were drowned, together with their Cattle, others had not ſaved themſelves but by climbing up Trees, and getting to the Tops of Houſes; and ſome others who were looking after their Cattle in the Field, warned by the Noiſe which this horrible and furious Torrent of Water (rowling towards them with a Swiftneſs like that of the Sea) in *Bretaigne* he means, made at a Diſtance could not eſcape without being overtaken, though they fled with much Precipitation: This nevertheleſs did not laſt many Hours with this Violence.

At the ſame time exactly, the two Rivers of *Adour* and *Cave*, which fall from the *Pyrenean Hills*, as well as the *Garonne*, and ſome other little Rivers of *Gaſcoynge*, which have their Source in the *Plain*, as the *Gimone*, the *Save*, and the *Rat*, overflowed after the ſame Manner, and cauſed the ſame Devaſtations. But this Accident happened not at all to the *Aude*, the *Ariege*, or the *Ariſe*, which come from the Mountains of *Foix*, only that they had more of the ſame than thoſe of the *Conſeruns*, the *Comminge*, and the *Bigorre*.

M. *Martel*, by the Order of M. *Foucault*, hath ſearched after the Cauſe of this *Deluge*, being aſſured that it muſt have had one very extraordinary. For all who had ſeen the Circumſtances agreed, that it had rained indeed, but that the Rain was neither ſo great, nor laſted ſo long, as to ſwell the Rivers to that Exceſs, or to melt the Snows off the Mountains.

But the *Nature* of theſe Waters, and the Manner of their flowing from the Mountains, confirmed him perfectly in his Sentiments. For, 1. The Inhabitants of the *Lower Pyreneans* obſerved, that the *Water* flowed with Violence from the Entrails of the *Mountains*, about which there were opened ſeveral Channels, which forming ſo many furious Torrents, tore up the Trees, the Earth, and great Rocks, in ſuch narrow Places where they found not a Paſſage large enough. The Water alſo which ſpouted from all the Sides of the Mountain in innumerable *Jets*, which laſted all the Time of the greateſt overflowing, had the Taſte of the Minerals.

2. In ſome of the Paſſages, the Waters were ſtinking, as when one ſtirs the Mud at the *Bottom* of the mineral Water, in ſuch Sort, that the Cattle refuſed to drink of it, which was more particularly taken notice of at *Lombez*, in the overflowing of the *Save* (which is one of the Rivers) where the Horſes were eight Hours thirſty before they would endure to drink it.

3. The Biſhop of *Lombez* having a Deſire to cleanſe his Gardens, which the *Save* paſſing thorough by many Channels by this overflowing, had filled with Sand and Mud; thoſe which entred them felt an Itching, like to that which one feels when one baths in *Salt Water*, or waſhes one's ſelf with ſome ſtrong *Lixivial*. This *Itching* could not be produced by either *Rain* or *Snow Water*, but by ſome *mineral Juice*, either *Vitriolick* or *Aluminous*, which the Waters had diſſolved in the Bowels of the *Mountains*, and had carried along with it in paſſing through thoſe numerous Crannies.

For theſe Reaſons M. *Martel* believes the true Cauſe of this overflowing to be nothing elſe but *ſubterraneous Waters*. And to explain the Means of this *Irruption*, he ſuppoſes that there is in the Earth a great Number of *Baſons*, *Cavities*, or great *Receptacles* of a vaſt Extent full of Water, from which by diverſe Iſſues into lower Paſſages there gets and runs out Water enough to furniſh that which runs above the Earth, during the Seaſons that it rains little or nothing.

One cannot well doubt of the Truth of this Suppoſition, if he conſiders, 1. That in *Mines* as well as in *Pits*, the more one digs, the more abundance of *Water* is met with. 2. That there are *Rivers* that the *Earth* ſwallows, as that of *Guadalquivir* in *Spain*, and others that guſh out of it complete *Rivers*. 3. That there are *Gulphs* in diverſe Parts of the Sea. 4. That there are *Lakes* without *Bottoms*, conſonant to what *P. Kircher* remarks in his *Mundus ſubterraneus*, which diminiſh not at all, and yet receive little or nothing of *Water* from above. Such as are in the ſame *Pyrenean Mountains* in the *Lake* of *Berwale* of *Barboiau*, and St. *Pé*: 5. And to conclude, That there are found in *Caves* vaſt *ſubterraneous Lakes*; as amongſt others, that in a Cave near *Grenoble*, of which *Francis* the *Firſt* had the Curioſity to deſire to know the *Extent*, having cauſed a *Boat* to be made for this Purpoſe. Hence we muſt conclude, that the *inner Parts* of the *Earth* are like a Spunge dipped in *Water*, and ſoaked on every Side; or like our Body filled with differing Veſſels which are the Canals, through which the Blood is communicated to the whole Body.

This being ſo, 'tis not at all difficult to underſtand how the *Earth* thus conſtituted may ſuffer, in Proceſs of Time, great Changes within its Bowels, as well as on its Superficies, where the *Parts* of *Mountains* and vaſtly great *Rocks* ſeparating and tumbling down, cruſh ſometimes whole Towns, as it happened in the Year 1618, to the *Town* of *Pleurs* in the *Valtolen*, by the Fall of a Rock which hung over that Town. This Matter is more eaſily to be done in the Bowels of the *Earth*, becauſe the *Waters* or *ſubterraneous Rivers* do ſoak, and by degrees undermine the Parts of the *Earth*, which uphold the heavieſt *Mountains*; whence it muſt neceſſarily follow, that theſe ſame *Mountains* muſt ſink down in Proportion to the *Maſs* they have loſt. And 'tis certain that ſomewhat like this happened in theſe *Mountains*, for the People which inhabited thoſe Parts, have ſeen the *Earth cleft* in diverſe Places, and have obſerved alſo, that in ſome Places there have happen'd *Founderings* of the *Earth* for a very conſiderable Extent, one Part of the *Mountain* being *ſeparated*, ſunk down, which appeared by the profound *Clefts* many Feet deep, but of little Breadth. So this *Maſs* of the *Mountain* in its *ſettling* all at once upon the *Water* of the *Gulphs* or *ſubterraneous Lakes*, which are under the higheſt *Pyrenean Mounts*, in all the *Extent* they take up from *Le Foix*, even to *Bern*, do force the *Water* to guſh out altogether with great Violence to the ſame Quantity with the Bulk of that Part of the *Mountain* which is *ſettled* in the *ſubterraneous Lakes*, which is the Cauſe of this prodigious overflowing.

But that which will not ſuffer me to doubt at all but that there was ſome ſuch *ſubterraneous* tumbling down, is this, that three *Months* after this furious *Inundation*, that is to ſay, about the end of *September*, there happened a ſecond *overflowing* in ſome Places near to thoſe where the firſt happened, which made alſo great Spoil, particularly that which came from the River of *Ariege*. And 'twas then remarkable, that a Fountain that runs from a Rock upon the *Lot*, near the *Cahors*, conſiderable for the Abundance of its *Water* which turns three Mills at its very Source, became all red, which was never ſeen before in the Memory of Man.

Some Effects *of* Vitriolate Waters; *by* Mr. J. Beaumont, *Ph. Coll.* n.8. p.6.

2. One *William Dally*, an able Miner, being employed at *Week* in *Glocesterſhire*, about two Miles from *Kenyſham*, to renew an *old Work* which was about ſix *Fathom* deep, and was more than half full of *Water*, he drew what he could out with a *Bucket*, and then he went down into the *Mine*, to clear out the Remainder. Having ſtood in the *Water* ſome Days, his Legs began to itch extreamly, and ſwelled very much, and at length broke out into Sores. I enquired of him how the *Ore* lay in its *Mine*, and he told me the Vein of *Ore* grew in the Middle of a Vein of *Sulphur* (as he called it) that is, *Marchaſites*, which was about a *Yard* wide; from this I eaſily gathered, that the *Waters* in the Mine having ſtood a long Time on that large Bed of *Marchaſites*, was ſtrongly impregnated with the *Vitriolate Salts*, which abound in them, and was the Cauſe of the *itching* and *ſwelling* of his Legs.

An Inundation *in* Ireland, *by Dr.* Hook, Ph. Coll. n. p. 1.

XXXIII. *June* 26th, 1680. An *Inundation* happened not far from *Londonderry* in *Ireland*, more monſtrous than that in *Gaſcoygne*. 'Tis ſuſpected that both proceeded from ſome extraordinary Change in the *ſubterraneous Caverns* of thoſe Hills from whence the *Water* guſhed, very few *Mountains* being without them.

Inundations *in* Yorkſhire *by Mr.* R. P. n. 245. p. 382.

XXXIV. 1. The *Inhabitants* of *Kettlewell* and *Starbotton*, in *Craven*, in the *County* of *York*, ſuffered a very great Loſs in *June* 1686, by a ſudden *Overflow* of *Water*. The Towns are ſituate under a great Hill on the Eaſt and Weſt; the Country is very *mountainous* and *rocky*. The Deſcent of *Rain* was after a Thunder-clap, for about the Continuance of an Hour and half, with extraordinary Violence, and by ſeveral Eye-witneſſes the *Rock* on the Eaſt-ſide open'd viſibly, and Water they beheld thence into the *Air* the Height of an ordinary Church-ſteeple, ſo that the *Current* of *Water* came down the Hill into the reſpective Towns, as in one entire Body, and with a *Breaſt* as if it would have drowned the whole Town, ſeveral Houſes were quite demoliſhed, and not a Stone left; others gravelled to the Chamber-Windows; ſome Inhabitants driven until this Day from their Habitations, the *Current* of the *Water* running thro' their Houſes; mighty Rocks deſcended from the *Mountains* into the *Valley*, and there lay unmoveable; many fair Meadows covered with Sand and Stones, that the Worth of the Soil will not regain the ſame; Houſhold-goods taken away into the great River of *Wharſe*, and ſo loſt, beſides many quick Goods. The Loſs reputed to be many thouſand Pounds; many Families quite ruined, others in Part only.

There have been two other Floods ſince the firſt, tho' not ſo great and dangerous. The *Becks* or *Currents* of *Water* which run thro' theſe Towns, were ſo gravelled up by the firſt Flood, that the Paſſage is much altered, and cannot be regain'd, though there have been many Hundreds of Men ſet to do it.

2. *March* 22d 169$\frac{6}{7}$, at half an Hour after 12 o'Clock, being calm, but a little rainy Weather, the River which paſſeth by the plain Ground of *Noordwyck*, did in the Space of a quarter of an Hour ſwell to that Height, that the *Sugar-mill*, the *Sugar-work*, and almoſt all the ſaid Ground was thereby ruined, the moſt Part of the *Sugar-Canes* being rooted or torn out of the Ground by the Violence of the *Torrent*. We cannot imagine whence ſo ſudden a Swelling of this River has been cauſed, while the *Rain* not being very hard, could not be of that Effect; for, in ſuch a Caſe, it ſhould have continued longer; for, about 12 o'Clock, when the Company's Servants aſſembled for their Dinner, the Water of the *River* was at its ordinary Height, and before they had half dined all the Country was overflowed by the Water, *viz.* one Foot higher than two Years ago, by Reaſon of the *Hurricane*, when we had as violent a Storm as ever we heard of. And at one o'Clock all the extraordinary Water was gone, and the River again at its ordinary Height. There has been no *Earthquake* that could cauſe it, neither was there any ſuch Thing in other Rivers.

In Mauricius Iſland; *By* M. Roel *of* Diodati; n. 241. p. 268.

XXXV. In Order to compare the Quantity of *Rain* with the Quantity *Water* running away in *Springs* and *Rivers*, it is neceſſary to meaſure ſe two Sorts of *Water*. Thoſe that make Profeſſion of governing and veying *Spring-waters*, ſay, that a Cubick Inch of *Water* yields in 24 urs, 144 *Muids*, (the Name of a *French Meaſure* holding 280 *French* ts;) others ſay, it yields but 70 of that Meaſure.

The Origin of Fountains and Rivers, by M. - - n. 119. p. 447

But I have Reaſon to believe, that it yields 83 of this Meaſure, and fol- w thoſe that ſay, that a Veſſel of two Foot deep, long and broad, holds e *Muid* of *Water*.

And therefore if a *Conſervatory* ſhould hold 3378 *Muids* of *Water*, it would furniſh for a whole Year a ſufficient Quantity to make an *Inch* of *Water* run conſtantly. As for the Meaſure of *Rain-water* I have found by *Obſervations*, that from *Oct.* 1668, to *Oct.* 1669, there had fallen ſo much of it as mounted to the Height of 18 Inches 7 Lines; and from the ſame Month 1670, to the ſame Month 1671, there happened only ſo much as came to the Height of 8½ Inches; and from *Jan.* 1673, to *Jan.* 1674, to the Height of 27½ Inches. Of which, taking the *Medium*, we have 19 Inches and 2½ Lines.

This ſuppoſed, let us eſtimate ſome River, as it runs from its very *Source* to a Place where ſome *Rivulet* enters into it, and ſee, whether the *Rain-water* that falls about the Courſe thereof, if it were put into a *Conſervatory* would be ſufficient to make it run a whole Year. In order to this, I have conſidered the *Seine*, which from its *Source* to *Ainay le Duc* is about 3 *Leagues* long, and the Sides of its Courſe extend themſelves on the Right-hand and the Left about two Leagues on each Side, where there are other little Rivers that run another way: And, ſince that thoſe *Rivulets* need *Water* to maintain them as well as the *Seine*, I will count but half that Space of the Sides, and ſay, that the Place where the *Seine* paſſes hath from its Source to *Ainay le Duc* three Miles long, and two Miles large. Whereupon I ſay farther, if a *Conſervatory* were made for this Bigneſs, it would be ſix Square *Leagues* in Surface, which being reduced to *Fathoms*, would make 31245144 Fathoms in Surface. In this Conſervatory, imagine that during a whole Year there has fallen Rain to the Heighth of 19 Inches 2½ Lines, as was ſaid before. This Height of 19 Inches and 2½ Lines, gives 280899942 *Muids* of *Water*, or thereabout, according to the Meaſure ſuppoſed.

All this *Water* thus collected is that Stock which is to ſerve to make this *River* run for a whole Year, from its Source to the Place before named, and which muſt alſo ſerve to ſupply other Occaſions and Loſſes, ſuch as are the feeding of *Trees*, *Herbs*, *Vapours*, and extraordinary Swellings of the River whilſt it rains, and *Deviations* of the *Water* running another way.

Concerning the Meaſure or Eſtimate of the *Water* of this River, it would be difficult to find it juſt and preciſe, and to determine what Quantity it furniſhes. Yet ſo far as I was able to judge, it can have no more than 1000 or 1200 *Inches* of *Water* always running, compenſating the leſſer Quantity it hath at its Source with the greater it hath towards *Ainay le Duc*: The which I ſo judge by the Compariſon I make of theſe Waters with thoſe of the River of the *Gobelins*, in the Condition wherein it is towards *Verſailles*, where it hath 50 Inches of *Water*, according to the Meaſure taken of it. So that I eſteem it will be enough to allow twenty-four or twenty-five Times as much to our River. For the Channel of it is to be four or five Fathom large, and for Depth it is but ſhallow, it carries no Boats, and ſerves only to float down ſome looſe Billets.

Theſe Particulars being thus ſuppoſed, I ſay, that 1200 *Inches* of *Water* do furniſh in 24 Hours 99600 *Muids* of *Water* after the rate of 83 *Muids* to an *Inch*, that is, 36436000 for a whole Year. And therefore taking this Quantity

tity of 36½ Millions from the 280 Millions, that falls into the *Conſervatory*, above deſcribed, there will remain yet above 188 Millions of *Muids*, which amounts to almoſt five Times as much, and which ſerves to furniſh for the Loſſes, Diminutions, and other Waſtes above taken notice of. So that there needs but the 6th Part of the Rain and Snow-water that falls in a Year, to run continually thro' the whole Year.

Now if theſe *Rain-Waters* are ſufficient to make one River run, they may alſo ſuffice for all the reſt in Proportion; conſidering eſpecially, firſt, what remains for waſte, which is ſuperabundant; and *ſecondly*, what little Space I allow to both Sides of the River's Courſe, which is but of one League on each Side. For Rivers are not commonly two Leagues near one another.

It may be objected, that there are Countries where it rains but ſeldom, but ſomewhere it rains not at all, and yet there are conſiderable Rivers. But I anſwer, that the Rivers of thoſe Countries where it rains but ſeldom, do not run continually, being only big in Winter, but in Summer almoſt quite dried up. The Reaſon of both which Effects is, that they being nigh ſome high Mountains whence they come, the Snow that falls in Abundance on thoſe Hills, and is melted afterwards, is able, as long as that Water laſts, to make them run abundantly in Winter, leaving them dry when it ceaſes in Summer.

As for the Countries where it rains not at all, there are but few of them in the World. The *Torrid Zone* (where that may be more true than any where elſe) is a *Climate* abundantly moiſtened with *Rains* twice a Year, and it may be more than theſe *Northern Countries*, at leaſt in greater Plenty at certain Seaſons. But if there ſhould be any Countries where no Rain at all ſhould fall, that will not hinder the running of *Rivers* there, becauſe they may have their Sources in other Countries where it rains, as the *Nile* in *Ægypt*, where it rains not.

Mineral Springs; *about* **Paderborn** *in* **Germany,** *by* - - - **n. 7. p. 133.**

XXXVI. 1. About two Leagues from *Paderborn*, is a treble Spring called *Metborn*, which has three *Streams*, two whereof are not above one Foot and an half diſtant from one another, and yet of ſo differing Qualities, that whereas one of them is limpid, blewiſh, lukewarm, bubbling, and holding *Sal-Armoniac*, *Ochra*, *Iron*, *Vitriol*, *Allum*, *Sulphur*, *Nitre*, *Orpiment* uſed againſt *Epilepſies*, bad *Spleens* and the *Worms*; the other is Ice, cold, turbid, and whitiſh, much ſtronger in *Taſte*, and heavier than the former, holding much *Orpiment*, *Salt*, *Iron*, *Nitre*, and ſome *Sal-Armoniac*, *Allum* and *Vitriol*; of this all Birds obſerved to drink of it do die; which I have alſo privately experi- nted by taking ſome of it home, and giving it to Hens, after I had gi- them *Oats*, *Barley*, and **Bread Crumbs**: For ſoon after they had drunk t, they became giddy, reeled and tumbled upon their Backs, with Con- ſion Fits, and ſo died with a great Extention of their Legs. Giving them mmon *Salt* immediately after they had drunk, they died not ſo ſoon; gi- ng them *Vinegar* they died not at all, but 7 or 8 Days after were troubled th the *Pipp*. Thoſe that died being opened, their *Lungs* were found quite rivel'd together. Yet ſome Men that are troubled with *Worms*, taking a little Quantity of it, and diluting it in common Water, have been obſerv'd by this means to kill the *Worms* in their Bellies, ſo that a great Number of *Worms* came from them; whereupon tho' they are ſick, yet they die not. As to the 3d Stream that lies lower than the other two, about 20 Paces diſtant from them, it is of a greeniſh Colour, very clear, and of a ſour ſweet Taſte, pleaſing enough. It hath about a middle Weight between the other two, whence we gueſs that it is mixed of them both, meeting there together; to confirm which, we have mixed equal Quantities of theſe Two, with an Addition of a little common *Well-water*, and have found, that they being ſtirred together, and permitted to ſettle, made a Water juſt of the ſame Colour and Taſte of the third Stream.

At Baſil, *by* - - - - ib. p. 234.

2. At *Baſil*, the Spring running in the *Gerbergaſſe* (or *Tanners-ſtreet*) from St. *Leonard*'s-*Hill*, is of a blewiſh Colour, and ſomewhat troubled, holding *Copper*, *Bitumen*, and *Antimony*, about three Parts of the firſt, one of the 2d, and two of the laſt; and have been examined by ſkilful Perſons. Our *Tanners* do water their Skins in it, and being a well-taſted and wholeſome Water, it is both much drank, and uſed to bath in.

There are two others, called *Randulph*'s *Well*, and *Brun Zam Brunnen*, very obſervable: The former of them having a Camphory and drying Quality, and uſed againſt hydropical Diſtempers; the latter containing ſome *Sulphur*, *Salt-petre* and *Gold*, and being an excellent Water to drink.

Near Yeoville, *in* Somerſetſhire, *by Dr*. J. Beal, n. 18. p. 323. n. 20. p. 359.

3. Mr. *Philips*, of *Montague*, has in his Paſtures of *Socke*, about 3 Miles from *Yeoville*, a large Pool to which Pigeons reſort, but the Cattle will not drink of it, no not in extream want of Water. To the *Taſte* it is not only brackiſh, but hath other loathſome Taſtes. In a *Venice* Glaſs it looked greeniſh and clear, juſt like the moſt greeniſh Cyder as ſoon as it is perfectly clarified. I boiled a Pint of it in a Poſnet of Bell-metal, and ſuddenly it yielded a thick Froth, having ſomewhat of a vitriolate Taſte. Suffering the Water to be boiled all away, it left much of the ſame on the Sides and Bottom of the Poſnet.

On Malvern Hill *in* Herefordſhire, *by Dr*. J. Beal; n. 20. p. 358. n. 57. p. 1161.

4. There is a *Spring* near the Top of *Malvern Hill*, having a long and old Fame for *healing of Eyes*; and about a *Furlong* lower is another *healing Spring*. When I was for ſome Years moleſted with *Tetters* on the Back of one and ſometimes of both my Hands, notwithſtanding all Endeavours of my very friendly and ſkilful *Phyſicians*, I had ſpeedy healing from a neighbouring *Spring* of far leſs Fame. Yet this *Spring* healed very old and ulcerous Sores on the Legs of a poor Fellow, which had been poiſoned by *Irons* in the *Goal*, after other Chirurgery had been hopeleſs. And by many Trials upon my Hands and the *Tetters*, I was perſuaded, that in long *Droughts*, and laſting dry *Froſts*, thoſe *Waters* were more effectually and more ſpeedily healing, than at other Times. I held this *Water* in my *Mouth* till it was warm, and perchance ſomewhat intermingled with *Faſting-ſpittle*, and ſo dropping it upon the *Tetter*, I there could ſee it immediately gather a very *thin Skin* upon the raw Fleſh, not unlike that which is ſeen to gather upon *Milk* over a gentle Fire. This *Skin* would have ſmall Holes in it, thro' which a Moiſture did iſſue

in ſmall Drops, which being wiped away, and the Water continued to be drop'd warm out of the Mouth, the Holes would diminiſh, and at laſt be all quite healed up.

For the Eye-Waters, I conceived them more ſtrongly *Terſive*, and clearing the Eyes; and they had a rough Smartneſs, as if they carried Sand or Gravel into the Eye.

5. I think the Waters we call *Chalybeate*, and particularly this at *Farrington*, to be impregnated principally from the *Vitriol*, or *Salt* of *Iron*, which is very Volatile; ſo that little of it can be found by Evaporation of a great Quantity, or from the precipitated Sediment. I put 4 Ounces of ordinary clear Water into a Glaſs, and impregnated it with a known Proportion of *Gall:* Then by Degrees I let fall into it the *Salt* of *Iron*, until I found it thereby as deeply tinged Red, as the ſame Quantity of *Farrington-waters* would be by the ſame Proportion of *Gall:* The Quantity of the *Salt* of *Iron* that performed this, was near two *Grains*. This Water, ſo tinged, taſted and ſmelled juſt as the natural Water from the Spring with *Gall* did: If I added a greater Proportion of *Salt*, it would make it nauſeous and *Emetical*.

At Farrington *in* Dorſetſhire; *By Dr* Highmore, n. 56. p. 1130.

It begins to be in high Eſteem for extraordinary Cures of the *Scorbute*, *Aſthma*, &c. It hath [as I have found upon Trial] a larger Proportion of the *Minerals*, than *Aſtrop-water*; but the Force holds not, if removed from the *Spring-head*.

n. 51. p. 1039.

6. About a Mile and half out of *Durham*, on the North-eaſt-ſide near *Butterby*, is lately diſcovered a *Medicinal Spring*, which is this Year much frequented, and may be of great Benefit to the Country. It was found out by Workmen that dug in that Place for Coal. When they were 12 Fathom and an half deep, they diſcovered this Treaſure of *Natural Phyſick*. They then tried the Rock about 100 Yards off; where they loſt themſelves much about the ſame Depth; and inſtead of *Coal* diſcovered a *Spring* of excellent clear Water, which iſſues out at the Hole which their Inſtruments made.

In the Biſhoprick *of* Durham. *By* Mr. Hugh Todd, n. 163. p. 727.

7. At *Lancarim* in *Glamorganſhire*, is a *Medicated Spring*, much frequented from ſeveral Counties, Time out of Mind, for the *King's-Evil*. There is a Rill of about an Ell broad between two Collines, covered with Wood; about 12 Yards from this Spring, the Rill falls from a Rock 8 or 9 Foot high, which makes a grateful Noiſe; the Spring (which is exceeding clear) comes out of a pure white *Marle*; tho' I thought there had been no white *Marle* in *Wales*, for the Earth is red. A *Graduate Doctor* hereabouts imputes the Virtue of this Spring to the *Lime-ſtone*; and ſays, one of the chief Ingredients of the Doctors for the *King's-Evil* is *Lime-water*.

In Glamorganſhire; *By* Mr. Aubry, n. 233. p. 727.

8. I had a *Mineral Water* ſent me, not long ſince, by Mr. *Duncan* (a Surgeon) from *Eglingham* in *Northumberland*. I found it turned almoſt quite Black with *Galls*, though it had been brought at leaſt 30 Miles by Land-Carriage. After I had ſlowly, in a Glaſs, evaporated more than one half of this Water, it ſtill retained the ſame *atramentous* Quality, and ſtruck yet as deep with *Galls* as ever; and at laſt it yielded me a real and genuine *Vitriol*. I ſay nothing of the *Ocre* which this Water let fall in very great Plenty that being a Thing common to all *atramentous Waters*.

At Eglingham *in* Northumberland; *By Dr.* Cay, n. 245. p. 365.

I was ſurprized at this Phænomenon: For I could not bring myſelf to think it poſſible, that the *Pyrites*, lying conſtantly under *Water*, ſhould ever yield *Vitriol*; and I knew of nothing elſe (at leaſt in *England*) that I could expect it from. But having lately an Opportunity to viſit this *notable Well*, I found our mighty Rarity, our *vitriol Water*, to be only an old *Drift* made for the draining of a Row of old wrought *Coal Pits* a little above, and I informed myſelf from ſome old Men, that had formerly wrought in theſe Pits, that there was Plenty of the *Pyrites* there, by them called, *Braſs Lumps*; and that this *Drift* was ſometimes dry, and ſometimes ran with a plentiful Stream; which is as fair and full an Account how this Water comes to have *Vitriol* in it, as any one need to deſire.

At St. A-mand *near* Tournay; *by Mr.* Geoffry, n. 347. p. 430.

9. There has been found a *Mineral Water*, called St. *Amand*'s-*Water*, which has been very much in uſe the laſt Summer and Autumn, in all Sorts of Sickneſſes, rather for its Novelty, than for its great and extraordinary Properties. It is called St. *Amand*'s-*Water*, becauſe its Spring is in the Land depending on the *Abby* of the ſame Name, of the Order of St. *Benedict*, in the Dioceſe of *Tournay* in *Flanders*; but the *Fountain* is called particularly, *La Fountaine du Bouillon*, for the impetuous boiling of that ſpringing Water.

This *Fountain* is ſituated in a ſhallow and marſhy Ground; the Baſon of the Spring is 450 Foot ſquare, there is in the *Bottom* of that Baſon the *Mud* of 20 Foot deep; beyond that they find the Sand, which ſometimes is very moving, and at ſome other times is very firm. Very often this *Fountain* caſts up a great Quantity of Sand: And laſt Year in a little time it caſt up more than 16 Cart Loads of it, by the which all the Baſon was border'd.

There is to be found three Sorts of *Earth*; the firſt and ſuperficial is black, and burns as Turf, with the ſame Smell; the ſecond is white; and the third has the ſame Colour as the *Slate*. Theſe two laſt Sorts of *Earth* do give by *Lixivium*, a *Salt* like *Sal Gemmæ*.

This St. *Amand*'s-*Water* in its Spring is clear and *Lukewarm*, and appears much *hotter* at Night and in the Morning, than the reſt of the Day. It has the Smell and Taſte like ſtanding *Water*. If it is expoſed to the Air it loſes its Smell and Taſte in a ſhort Time. By that Facility to loſe its Taſte and Smell, one may judge that it has a *Sulphur* very *Volatile*; and for that great *Volatility* and *Subtility* it is almoſt impoſſible to make any Experiment upon it.

This *Mineral Water* has the ſame Weight as the *Seine* River Water. It altered not the Colour of the *Syrup* of *Violets*, nor the *Tincture* of *Turne Sol*, *Lime Water*, the *Oil* of *Tartar*, the *Volatile Spirit* of *Sal Armoniack* and *Hart's Horn* have *whited* that *Water*, and have made it a light *Coagulum*.

This Water, mixt with the *Diſſolution* of *Armoniack Salt*, has not given any Smell. It has not altered the *Infuſion* of *Galls*. Mingled with the *Solution* of *Vitriol*, has troubled it a little, and has given a greeniſh Colour; and at length is precipitated a *yellow* Powder.

Acid Spirits have not *fermented* at firſt with that *Water*, but afterwards it has made ſome little Bubbles which remained to the Side of the Glaſſes wherein were contained the Liquors.

I have diſtilled five Pints of that *Water*; the diſtilled *Water* has not had any Taſte nor Smell, and it has not changed the Tincture of *Turne Sol*, neither the *Lime-water*. There remained from that five Pints (or 160 Ounces) 70 *Grains* of *Reſidue*; the which, by *Lixivium* has given to me 55 *Grains* of grey Earth, and 15 *Grains* of *white Salt*, almoſt like *Sal Gemmæ*.

The *Reſidue* of the evaporated *Water* put upon the burning Coals, has not caſt any Smoak, neither has made any *Detonation*; the *Spirit* of *Nitre* poured upon it, has very much *fermented*; the *Spirit* of *Wine* has not extracted any *Tincture* from that *Reſidue*.

One may conclude by all theſe Experiments, that this *Water* has not any *Acidity*, it participates not of *Vitriol*, nor of *Alum*; and there is in it but a little Quantity of the *white Earth*, and leſs alſo of *Salt* very like *Sea Salt*.

They are the Parts of *Earth* and *Salt*, which ſhew themſelves in the Mixture of the *Lime-water*, *&c.* of *fixed* or *volatile Alcalis*.

They are the ſame Parts which begin that light *Fermentation* in the Mixture of *Acid Spirits*; but that *Fermentation* is imperfect becauſe of the little Quantity of the *Earth*, which is drown'd in ſo great a Quantity of Liquor; in Effect when the *Water* is *evaporated*, the *Acid Spirits* do *ferment* very much with the *Reſidue*.

It appears by the Smell of that *Water*, that it contains a *Sulphur* very *ſubtile*, which diſſipates itſelf very eaſily, and which is not ſenſible in the Experiments. 'Tis nevertheleſs to be attributed to that *Sulphur*, the principal Effects which they do attribute to that *Mineral Water*, as of helping in the *Palſy*, *&c.* In other Sorts of Diſtempers where the *nervous Gender* is attack'd; in *ſhort Breath*, and in all Affections of the *Lungs*; and of remedying many other Infirmities which are cauſed by the *ſharp Ferments*, the which are ſweetned by that *Water*: For the other Properties of it, as of *Purging*, of taking away Obſtructions, of tempering the *hot Intrails*, *&c.* it may have the ſame Effects with common Water being drunk abundantly.

One may drink many Glaſſes of this *Water*, beginning by 4, 6 or 8 every Morning, and augmenting till 12, 18, 20 or more, according as the Stomach is able to ſupport it. This *Water* paſſes readily by *Urine*, and many Perſons are purged by it. Sometimes one may mix with it ſome *Diuretick Salts*, to make it paſs more freely, and for rendering it more *De-obſtructive*. At other times one may put ſome *Manna* or other Things for making it more *Purgative*. One may waſh alſo in the Mud of that *Fountain*, according to Neceſſity.

XXVII. I have obſerved a *Spring*, that in all the extream Froſts, that have been theſe 10 Years, hath yielded a ſmall Stream, which running over a [illegible] Tract of Paſture, keeps all the Banks and Borders *Green*, and free from *freezing*, diſſolving the *Snow*, and *ſmoaking* all the way where it runs.

A Spring *that is never frozen; by Dr.* J. Beale, n. 56. p. 1139.

XXXVIII. 1.

The Baths in Somerſet-ſhire; By Mr. Joſ. Glanville, n.49. p.977.

XXXVIII. 1. The Country round *Bath* is very hilly and uneven; but the Hills lie in Order; they are generally rocky and ſteep from South-Weſt and by Weſt, to North-Eaſt and by North: The whole Tract of the Country, within five and ſeven Miles, abounds with Coal-Mines, more or leſs. But there are no other conſiderable Mines that I can hear of, nearer than *Mendip*, which is 10 Miles hence, excepting ſome of Lead at *Berry* in *Glouceſterſhire*, which lies upon the *North* of this Place, about four or five Miles diſtant.

2. The Hills for the moſt part afford a Free-ſtone; and on the North-Weſt of *Lanſdown* (which hath that Situation to the Town, and is juſt above it) the Stones digged there are a Sort of Head Stone, commonly called a *Lyas* blue and white, poliſhable.

3. The *Town* and *Baths* are of very great Antiquity. Beſides what I find in very ancient Chronicles to that Purpoſe, one of our great Antiquaries (Mr. *P.*) aſſerts, that theſe *Baths* were 800 Years *before Chriſt*: which if ſo will give Occaſion to enquire, how conſiſtent with it that Hypotheſis concerning the Cauſe of the *Heat* of theſe *Waters* may be, which makes it to be the *Fermentation* of Minerals *in fieri*; and whether it be likely, that the Minerals through which theſe *Waters* paſs, ſhould be in that State of Imperfection ſo many hundred Years. But this other Opinion ſeems to me very probable which ſuppoſeth the Cauſe of the Heat to be, that two Streams having run through and imbibed certain Sorts of different Minerals, meet at laſt and mingle their Liquors, from which *Commixture* ariſes a great *Fermentation* that cauſes *Heat*; like as we ſee it is in *Vitriol* and *Tartar*, which when mingled beget an *intenſe Heat* and *Ebullition*.

4. It is affirmed here, that the Town for the moſt part is built upon a *Quagmire*, though the Places all about it are very firm Ground. Some Workmen, that have been employed in Digging, have found a *Mire* 10 Foot deep, without the *North* Gate, the higheſt Place of the Town, at *Seaven*. The *Earth* between is a kind of Rubbiſh; ſometimes they find *pitching* a Man's length under Ground, and Paſſages for the Water to paſs; ſeven or eight *Feet* down they have met with *Oyſter-ſhells*.

5. The *Town* and *Country* circumjacent, generally abound with *cold Springs*! And in ſome Places the *Hot* and *Cold* ariſe very near each other; in one Place, within *two* Yards, and in others, within 8 or 9 of the main *Baths*.

6. The *Guides* of the *Croſs-Bath* inform me, that when there is a great Weſt Wind abroad, ſtanding by the *Springs* they feel a cold Air ariſing from beneath: If the Wind be at Eaſt and the Morning cloſe with a little miſling Rain, the *Croſs-Bath* is ſo *hot* as ſcarce to be endured, when the *King's* and *Hot Baths* are *colder* than uſual. In other Winds let the *Weather* be how it will, this *Bath* is temperate. The *Springs* that *Bubble* moſt are *coldeſt*. The *Croſs-Bath* fills in 16 Hours, both in *Winter* and *Summer*, without any Difference from *Heat* or *Cold*, *Floods* or *Drought*; that of the *King* in 12 or 14 Hours.

7. A Man may better ordinarily endure four Hour's Bathing in the *Croſs-Bath*, than 1½ in the others. In the *Queen's-Bath* (which hath no Springs of its own, but comes all out of the *King's*) they have found under a flat Stone, which upon Occaſion was taken up, a Tunnel, and a yielding Mud in and under it, into which they thruſt a Pike, but could feel no Bottom. In the *King's-Bath* there is a Spring ſo *hot*, that it is ſcarce ſufferable; ſo that they are fain to turn much of it away, for fear of enflaming the *Bath*. The *hotteſt Spring* will not harden an Egg.

8. The *Bath-Water* does not paſs through the Body like other *Mineral Waters*; but if you put in *Salt* it purgeth preſently: Upon *Settlement* it affords a black Mud, uſeful in *Aches*, applied by way of *Cataplaſm*; to ſome more ſucceſsful than the very *Waters*. The like it *depoſits* upon *Diſtillation*, and no other; nor hath any more been diſcovered upon all the *Chymical* Examinations that have come to our Knowledge. One Dr. *Aſtendoff* found, that the Colour of the *Salt*, drawn from the *King's* and *Hot-Bath*, was yellow; that which was extracted from the *Croſs-Bath*, *white*. This Dr. concluded, that the *Croſs-Bath* had more of *Alum* and *Nitre* than the *hotter Baths*, which abound more with *Sulphur*. And yet that *Bath* looſens *ſhrunk Sinews*, by which it ſhould ſeem it abounds not much with *Alum*. It is harſher to the Taſte than the other *Baths*, and ſoaks the Hands more.

9. A Man cannot drink half the Quantity of ſtrong Drinks in this *Bath*, that he can out of it; but, if he hath drunk before to Exceſs, it allays much, and is a great Refreſhment to the Body. The *Bath* provoketh *Urine*.

10. They are very uſeful in *Diſeaſes* of the *Head*, as *Palſies*, *Epilepſies*, and *Convulſions*, in *Cuticular Diſeaſes*, as *Leproſies*, *Itches* and *Scabs*; in all *Obſtructions* of the *Bowels*, as *Spleen*, *Liver*, and *Meſentery*, and the *Schirroſity* and Hardneſs in thoſe Parts; in moſt *Diſeaſes* of *Women*; in the *Scurvy*, and *Stone*: As to which laſt, while I am writing, an Alderman of the City aſſures me, that his Wife, who had been exceedingly troubled with the *Stone*, went into the *Croſs-Bath* for it, and *voided* there ſeveral *Stones* as big as thoſe of *Olives*, and was never troubled with that Diſtemper after. The *Bath* is alſo good in *cold Gouts*, as they call them.

The ſame Alderman tells me, that it gives him preſent Eaſe, when he is troubled with the Fits of it. He uſes to go in as ſoon as the Fit takes him; which then goes off preſently, and returns not in a conſiderable time after: He puts his Feet upon the hotteſt *Spring* in the *King's-Bath*.

But it had a contrary Effect in *hot Gouts*; and ſome, who are troubled with that Diſtemper, tell me, that the *Bath* puts them in a Fit, if they go into it without Preparation; or, if they have the Fit before, it inflames it more, and ſends it about the Body, and diſables the Joint ſo, that there is no treading on it for the preſent. Further, the *Bath* is effectual in the *Diſeaſes* of *Children*, particularly the *Rickets*, removing the Humours that proceed from it without Fail. 'Tis alſo good for *Women*, that are apt to *miſcarry*, if uſed moderately. The *Bath-guides* go in, when they are apt to lie down; and other Women of the Town uſe it ordinarily throughout their Time, and are never obſerved to miſcarry. It facilitates Delivery. It is very effectual beſides for the ſtrengthening of *broken Bones*, and good in all *cold* and *moiſt Diſtempers*, and *Weakneſs* of *Nerves*, *Stupefactions*, *Relaxations*, and violent *Pains:* In all which it gives Eaſe, except the *Lues Venerea*; but in that (except the Malignity be overcome by the Methods of Phyſick) it exaſperates the Pain more. 'Tis an excellent Remedy to remove the remaining *Weakneſs* in *Gouts*, as hath been remarkably exemplified in Old Men, even to the Age of 83 Years.

11. There is no Inſtance of Cures performed by it in former Times, but we have the Experience of it in ours; yea, and in ſome others, as in *Dropſies*, *Cachexies*, *Spleen*, *&c.* in which Caſes they were ſhy heretofore of uſing the *Bath*, for fear of confirming thoſe *Obſtructions*; whereas 'tis now found that their Cure is facilitated by it.

12. The *Bath-Guides* live to a very great *Age*; ſometimes to near 100 Years; ordinarily, if they are temperate, to 70. There are two at this Time above 80, a Man and his Wife.

13. In the *Croſs-Bath* the *Guides* have obſerved a certain black Fly with ſealed Wings, in the Form of a *Lady-Cow*, but ſomewhat bigger. They ſay, it ſhoots quick in the *Water*, and ſometimes bites. It lives under the *Water*, and is never found but in very *hot Weather*. They ſuppoſe it comes up with the *Springs*. It is not to be ſeen elſewhere.

14. The *Croſs-Bath* eats our Silver exceedingly; and I am told that a Shilling in a Week's Time hath been ſo eaten by it, that it might be wound about one's Finger. The *Baths* agree (as the Vulgar ſpeak) with *Braſs*, but not with *Iron:* For they will eat out a Ring of this Metal in ſeven Years, when *Braſs* Rings ſeem to receive no Prejudice at all from it.

15. When Women have waſhed their Hair with the Mixture of beaten Eggs and Oatmeal, this will poiſon the *Bath* ſo, as to beget a moſt noiſome Smell, caſting a *Sea-Green* on the Water, which otherwiſe is very pure and limpid. This will taint the very Walls, and there is no cleanſing of it, but by drawing the *Bath*.

16. In Summer the *Baths* purge up a green Scum on the *Top*, but in Winter never; but then leave a yellow on the Walls.

17. The Walls that keep in the *hot Springs* are very deep ſet, and large; 10 Foot thick, and 14 deep from the Level of the Street. The *Cement* of the Wall is yellow Clay, Lime, and beaten Bricks. In the Year 1659 the *Hot-Bath* (a *Bath* particularly ſo called, of equal *Heat* with the *King's-Bath*) was much impaired by the breaking out of a *Spring*, which the Workmen at laſt found again, and reſtored. In digging they came to a firm Foundation of factitious Matter, which had Holes in it like a Pumice-Stone, thro' which the Water played; ſo that 'tis poſſible the Springs are brought together by *Art*: Whence probably was the *Necromancy* the People of antient Times believed and reported to have contrived and made theſe *Baths*; as in a very antient *Manuſcript* Chronicle I find theſe Words: *When* Lud. Hidibraſs *was decd*, Bladud *his Son, a great* Nygromancer (*ſo 'tis there writ*) *was made King*; *He made the Wonder of the* Hot Bath *by his* Nygromancy;

mancy; *and he reigned* 21 *Years, and after he died and lies at the* New Troy. And in another old Chronicle 'tis ſaid, *That King* Bladud *ſent for the* Necromancers *to* Athens *to effect this great Buſineſs*; who, 'tis like, were no other than cunning Artificers, well skill'd in *Architecture* and *Mechanicks*.

18. It hath been obſerved, that *Leaves*, like thoſe of *Olives*, come ſometimes out of the Pump of the *Hot-Bath*.

By Dr. Pierce; n. 169. p. 944.

(2.) Theſe *Waters* have been long famous for the Cure of *Palſies* and *Barrenneſs*: An Inſtance of both in one Perſon I ſhall now give you. A Gentlewoman of about 30 or 32 Years of Age, having been married about 10 or 12 Years, and never with Child, was ſuddenly ſeized with a *Palſy* on the Left-ſide; for which (after 8 or 10 Months Trial of other Means to little Purpoſe) ſhe was brought to the *Bath*, where (after uſual Preparations, and ſome internal Means) ſhe continued that Seaſon about ſix Weeks; the Winter coming on, ſhe was forced to deſiſt; but (by the Advantage ſhe received) was encouraged to come very early the next Year, and did continue with us the whole Summer, and recovered, in great meaſure, the Uſe of her Arm and Hand, Leg, and Tongue; and not only ſo, but, in a few Weeks after, ſhe returned to her Husband, conceived with Child, and had (about a Year and half's Diſtance between them) five Children following. She ſhewed me four of them luſty and ſtrong, and well grown for their Age; the fifth died: She herſelf had no Return of a *Palſy*, but is *infirm*, I think, *conſumptive*: She is now about 51 Years old.

Baths *in* Auſtria *and* Hungary, *by Dr.* Edw. Brown; n. 59. p. 1044.

XXXIX. At *Baden*, a little City in *Auſtria*, 4 *German* Miles Southward from *Vienna*, ſeated on a Plain, but nigh unto a Ridge of Hills, which are the Excurſions of Mount *Cetius*, are convenient *Baths*; Two within the Town, Five without the Wall, and Two beyond a Rivulet called *Swechet*.

The *Duke's-Bath*, which is the largeſt, is about 20 Feet ſquare, in the middle of an Houſe of the ſame Figure, built over it. The Vapour paſſes through a Tunnel of Wood, at the Top. And the Water is conveyed into the Bottom of the *Bath*, at one Corner, through wooden Pipes and Trees, under the Town-Wall, from the Spring-Head, which riſeth at a little Diſtance Weſtward. The Springs of the reſt of the *Baths* riſe under them, and are let in through Holes of the Plancher; for all the *Baths* are wainſcoated, the Seats, Sides, and Bottoms being made of Fir. The Water, for the moſt part, is clear and tranſparent, yet ſomewhat blewiſh, and maketh the Skin appear pale in it, as doth the Smoak of *Brimſtone*. It coloureth Metals (except Gold, whoſe Colour it alſo heightens) turning them black in a few Minutes. The Coin of this Country, mixt of Copper and Silver (having $_{5}\frac{2}{1}$ of Silver, and $_{1}\frac{2}{5}$ of Copper, is in a Minute's Time turned from a white into a dark yellow, and ſoon after becomes black. To the Moſs and Plants, which it waſheth, it gives a fine green Colour, and leaves often a Scum upon them, of a purple mix'd with white. As it runs from the Spring-Head it ſomewhat reſembles the *Sulphur-River* in the way from *Tivoli* to *Rome*, but is not ſo ſtrong or ſtinking, nor doth it incruſtate its Banks.

I paſs'd

I paſſed to the Spring-Head (which riſeth under a rocky Hill) about the Length of 40 Yards, through an arched Paſſage cut in the Rock, which is alſo a *natural Stove* (as that of *Tritola* and *Bajæ*) made by the *hot Bath-water* running under it. Moſt Part of this Cave is incruſtated with a white Subſtance, by them called *Salt-petre:* At the Mouth of the Cave it becomes harder and ſtony.

I cauſed ſome of the Pipes, through which the *Bath-water* runs, to be opened, and from the upper Part of the Pipe I took ſome Quantity of *fine Sulphur* in *Powder*, ſomewhat like *Flower* of *Brimſtone*; this being as it were ſublimed from the Water, and not depoſed, being found in the upper Part of the Pipe. *Oleum Sulph. per Campanam*, dropped into this Water, is received into it quietly. *Oleum Tart. per Deliquium* cauſed an *Ebullition*, as in the making of *Tartarum Vitriolatum.*

The ſecond *Bath*, within the Wall, is that of our *Lady*, about 12 Foot broad, and 24 long. One End of it is under a Church of the ſame Name. This is fuller of Sulphur than the reſt, and more blew, and leaveth a yellow Flower upon the Boards, as the others do a white.

The third is the *New-Bath*, out of the Town nigh the Gate.

The fourth, the *Jews-Bath*, which hath a Partition in the Middle to ſeparate the Men from the Women.

The fifth, St. *John's Bath*, of a Triangular Form.

The 6th is called the *Beggar's-Bath*, and is always ſo ſhallow, that they lie down in it.

The 7th, the *Bath* of the *Holy Croſs*, about two Fathoms ſquare, chiefly for the *Clergy*.

The eighth, St. *Peter's Bath*, greener than the reſt.

The ninth, the *Sour Bath*, ſet about with Stone-balaſters, and covered with a Cupola and Lanthorn. The Water is very clear: In the Steam of this *Bath* I have often coloured Money black without touching the Water; and, ſtaying only in the Room where the *Bath* is, the Buttons of my Cloaths, and what elſe of Silver the Vapour could come at, were colour'd yellow, or gilded: And yet the Water itſelf once cold changeth not the Colour of Metals, though boiled in it.

The *hotteſt* of theſe *Baths* have not the *Heat* of the *Queen's-Bath* at *Bath* in *England*. They uſe no *Guides*, as with us, but direct themſelves with a ſhort turn'd Staff.

Manners-dorff, ſeated under an Hill on the Eaſt-ſide of the River *Leyta*, hath only one *Bath*. It riſeth under a Church, that is built over the Spring-Head.

The Water of it is *lukewarm*; and therefore they boil it in great Coppers, when they deſire it *hotter*, and *bathe* in Tubs filled with this boiling Water. From the Subſtance, which ſticks to the Coppers in boiling, it is collected, that it is impregnated with *Sulphur*, *Salt-petre*, and *Chalk*. This Water coloureth the Stones in it of a fair Green like a *Turkois*; and the Steam of it, which ſticks to the Moſs under the Church, turns into Drops of Gold or Amber.

Dotis, two *Hungarian* Miles from *Comorra* in *Hungary*, hath alſo ſulphurous Baths, ſaid to be warm in Winter. In *March* and *October* I found their Warmth very remiſs, ſcarce perceivable. In Colour they are blewiſh, and to Taſte acid. The Queen's-Bath and the Great-Bath riſe in a Marſh, Northward of the Caſtle.

There is another Bath in the Governour's Garden within the *Town*. They are uſed as thoſe of *Manners-dorff*.

At *Banka*, two *Hungarian* Miles from *Freiſtat*, in a Meadow, I took notice of 15 Baths: And there have been more, but the River *Waag* eateth away the Banks, and ſwallows up the Bath; and into three of theſe 15 it hath alſo broke in. The Water of theſe is like to that of *Baden* in *Auſtria*; it leaves a white Sediment upon the Moſs and Places it waſheth, and tinctureth Metals black. I ſtuck ſome Money into the Ground, over which the Water paſſeth; that Part which was in the Ground retained its own Colour, and the other Part in the *Bath-water* acquired a Coal Black. Theſe Baths are open, and very hot.

The Baths of *Boinitz*, nigh the River *Nitra* in *Hungary*, are of a moderate gentle Heat, much beautified by Count *Palſi*, Palatine of *Hungary*, and all of them covered under one large Roof; the firſt is the Nobleman's Bath, built of Stone, deſcended into on all Sides by Stone-Stairs: Four more there are of *Wood*, but very handſomely and well built.

At *Stuben*, three *Hungarian* Miles from *Newſol*, and two from *Chremnitz*, near to a Rivulet, are diverſe Baths of great Eſteem. The Water whereof is clear, and ſmells of *Sulphur*, the Sediment green. It colours the Wood over it green and black, but does not change the Colour of Metals ſo ſoon as moſt others. I left Money in it a whole Night, which was yet but faintly coloured. The Springs ariſe underneath, and paſs through the Holes in the Plancher of the Baths. The Heat thereof is anſwerable to the King's-Bath in *England*. Theſe Baths are ſeven.

The firſt is the Noblemen's Bath; the ſecond the Gentlemen's Bath; the third, the Country-man's; the fourth, the Country-woman's; the fifth, the Beggar's Bath; the ſixth, for ſuch as are infected with the *Lues Venerea*; the ſeventh, the Bath of the Gypſies, of whom there are many in thoſe Parts. Theſe *Baths* are in a Plain, encompaſſed on all Sides with Hills; the nigheſt unto them are towards the Eaſt, and it is the ſame Ridge of Hills, which on the other Side are ſo rich in Metals.

Glaſs-Hitten, an *Hungarian* Mile, or about 7 *Engliſh* Miles from *Schemnitz*, hath five Baths; two of which are large. It depoſes a red Sediment, and incruſtates the Wood and Seats of the Bath under Water with a ſtony Subſtance; and it alſo gildeth Silver. But the moſt remarkable of theſe Baths is that which is called the *Sweating-Bath*, whoſe hot Springs drain thro' an Hill, and fall into a Bath built to receive them; at one End of which, by aſcending, I went into a Cave, which is made a noble Stove by the Heat of theſe *Thermæ*, and ſo ordered with Seats, that every one who ſits in it, either by chuſing a higher or lower Seat, may regulate his Sweating, or enjoy what Degree of Heat he deſireth. This Cave as alſo the Sides of the

Bath are covered, by the continual dropping of thoſe hot Springs, with a red, white, and green Subſtance; the red and green make the beſt Shew, but the white is uſed againſt the Stone, and cureth Ulcers, and ſore Backs of Horſes.

Eiſen-bach, about four *Engliſh* Miles from *Glaſs-Hitten*, and five or ſix from *Schemnitz*, hath alſo *Hot Baths*. I have ſeen great Trees placed at the Top or Superficies of the Water in theſe Baths, which have ſuffered Petrifaction. Here are two convenient Baths, much frequented; and a third, which is made by the Water let out of the former, called the *Snake's-Bath*, from the Number of *Snakes* coming into and delighting in it, when 'tis filled with theſe warm Waters.

The natural Baths of *Buda* are eſteemed the nobleſt of *Europe*, not only in reſpect of the large and hot Springs, but the Magnificence of their Buildings.

For the *Turks* bathe very much, and tho' little curious in moſt of their private Houſes, yet are they very ſumptuous in their publick Buildings, as their *Chans* or *Caravanſara's*, *Moſchs*, *Bridges*, and *Baths* declare.

There are eight Baths, whereof I had Opportunity to take notice, during my Stay at *Buda*; three towards the Eaſt and South Eaſt Part of the City, in the way leading towards *Conſtantinople*; and five toward the Weſt-end of the Town in the way towards *Old Offen*, and *Strigonium*.

The firſt is a large open Bath at the Foot of an high rocky Hill, formerly called *Purgatorium*, whereof the People have ſome odd and ſcrupulous Apprehenſions.

The ſecond is covered with a *Cupola*, and ſtands nigh the ſame Hill, but more into the Town, and near a Place where they uſe *Tanning*.

The third is called the *Bath* of the *Green Pillars*, tho' at preſent they be of a red Colour; and it ſtands over-againſt the *Caravanſara*. The Water is hot, but tolerable without Addition of cold Water. It is impregnated with a petrifying Juice, which diſcovers itſelf on the Sides of the *Bath* upon the Spout, and other Places, and maketh a grey Stone; and the Exhalation from the *Bath*, reverberated by the *Cupola*, by the Irons extended from one Column to another, and by the Capitals of the Pillars, formeth long Stones like *Icicles*, which hang to all the ſaid Places; ſuch as may be obſerved in many ſubterraneous *Grottoes*, and particularly in *England* in *Okey-Hole* in *Somerſetſhire*, and *Pooles-Hole* in *Derbyſhire*.

The Water is let out at Night, when the Women have done *Bathing*, who often ſtay late. The *Bath* is round, ſet about with large Pillars, ſupporting a *Cupola*, which hath Openings to let out the Steam thereof, and yet the whole Room continues to be a hot Stove.

The *Baths* of the Weſt-end of the *Town*, are;

1. *Tactalli*, or the *Bath of the Table*; a ſmall *Bath* covered: The Water white, and of a ſulphurous *Smell*.

They drink of this as well as bathe in it. What they drink, they receive from a Spout bringing the Water into this Place. I delivered a *Five-Sols* Piece to a *Turk*, bathing in it, to gild for me; which he did in about a

Minute, by rubbing it between his Fingers, while the hot Water fell from the Spout upon it.

2. *Barut Degrimene*, or the *Bath* of the *Powder-Mill*. It riſes in an open Pond near the High-way, and mixeth with the freſh Springs; ſo that the Pond is of a whitiſh Colour in one Part, and clear in the other, as alſo cold and hot in ſeveral Parts. This conveyed croſs the High-way into a *Powder-Mill* becomes uſeful in making of *Gun-powder*. They conceive here, that this Bath communicates with the ſulphurous Springs at *Dotis*, many Miles diſtant.

3. *Cuzzoculige*, the little Bath, or the *Bath of the Saint*; for which Name the *Turks* give a ſuperſtitious Reaſon. 'Tis kept by *Turkiſh Monks*; the Bath, where the Springs ariſe, is ſo hot as ſcarce to be endured; but, being let out into another Bathing-place at ſome Diſtance, it becomes tolerable, and fit for Uſe. This Water hath neither *Colour*, *Smell*, nor *Taſte*, different from common Water, and depoſeth a Sediment; only the Sides of the Bath are green, and have a fungous Subſtance all over.

4. *Kalip*, a very noble *Bath*; but Part of the Buildings were conſumed this Year (1669) by a great Fire which happened in *Buda*, but is by this time repaired by the *Turks*. The Water is very hot, not without petrifying Juice in it. The Buildings about it are eight Feet ſquare, with a noble Bath in the Middle, with a *Circle* or *Trench* of Water about it for the better Ornament. On every Side it has a *Nichio*, wherein is a Fountain. In the Middle of the *Anti-chamber* (where they leave their Cloaths) there is alſo a fair Stone Baſon, and a Fountain.

5. The *Bath of Velibey*, which hath a ſtrong ſulphurous Smell, and a petrifying Juice in it, and is ſo hot, that to make it tolerable it requires the Addition of cold Water, is the nobleſt Bath of any. The Anti-Chamber is very large, the Bath-room capacious and high-arched, and adorned with five *Cupola*'s; one, a very fair one, over the great round Bath in the Middle; and one leſſer, over each of the four Corners; where are either Baths or Bath-ſtoves for more private Uſe: In theſe the *Turks* take off the *Hair* of their Bodies by a *Pſilothrum*, mixed with *Soap*; it being not their Cuſtom to have any *Hair* except on their *Beards*, and a Lock on the Crown of their *Heads*. Twelve Pillars ſupport the great *Cupola*; between eight whereof are Fountains of the hot Water, and between the other are Places to ſit down, where the *Barbers* and *Bathmen* attend. And each of theſe Places have two Ciſterns of Free-ſtone, into which are let in hot Bath-water, and alſo cold Water, to be mixed and tempered, as every one pleaſeth.

Men bathe in the Morning, and *Women* in the Afternoon. When any Man intends to bathe, having entered the firſt Room, he finds there diverſe *Servants* attending, and furniſhing him with a *Cloth* and *Apron*. Then he puts off his Apparel, and having put on the *Apron* he entereth the ſecond Room, wherein the great Bath is, and ſits on the Side of the Bath, or between the *Pillars* nigh a Fountain; where the *Barber* ſtrongly rubs him with his Hand opened, ſtretching out his Arms, and lifting them up; after which the Party batheth. Then if he be a Subject of the *Grand*

Seignior's, or it be the Cuſtom of his Country, he hath his Head ſhaved; and, if a young Man, his Beard, except the upper Lip. Next, the Barber rubs his Breaſt, Back, Arms and Legs with an *Hair-cloth*, while he either ſitteth or lieth with his Face downward; then waſhes his Head with Soap, and after throws cold Water upon him all over his Body, and ſo the Party walks about in the Steam of the *Bath* for a time.

Theſe *Baths* are made uſe of two ways; either by entering into the Water, or ſitting about the *Bath* in the Steam. For the Vapour of the *Bath* makes the whole Room a Stove, and moſt ſweat as long as they ſtay in it; and ſome enter not the Water at all, but have it poured upon them, or elſe only continue in the Steam of the *Bath*, which ſufficiently provoketh Sweat.

At Aponum *near* Padua, *by Mr.* Doddington, n. 83. p. 4067.

XL. Five Miles from *Padua* are the Waters called *Aponenſia*, from a *Town* called *Aponum*. They are actually very *hot* and *ſtinking*, and yield a great deal of very fine Salt, of which the *Natives* ſerve themſelves in their ordinary Occaſions. The Salt is gathered after this manner: The *Natives*, after Sunſet, ſtir Pieces of Wood in the Water, and preſently the Salt ſticks to them, and comes off in ſmall Flakes, exceeding white, and very ſalt; this never loſeth its Savour. The People there with the ſame Water uſed to waſh their Walls, to render them whiter than ordinary; which it doth even whiter than *Lime*. Such *Walls* conſerve their *Saltneſs* ſome few *Days* only, and then become inſipid, even tho' they ſweat forth a white Excreſcence in thin and light Flakes, like *Nitre*, many Years after. But that Salt, that is collected from the Stones, Gravel, and Earth, by which the Rivulets deſcending from theſe Baths do run, is without any Taſte of Salt, though there be no Difference in the Form or Colour from that which is gathered with the wooden Inſtruments.

Hot Springs, *and other* Mineral Waters *in* Jamaica, *by Sir* William Breſton, n. 220. p. 226.

XLI. In *Jamaica* there is a very *hot Spring* of *mineral Water*, but the Diſtance and Trouble of getting to it has kept People from trying it 'till this laſt *Month* (*viz. March* $169\frac{5}{6}$.) when two Perſons, the one very much macerated with the *Belly-Ach*, and another with the *Pox*, as is ſuppoſed, went to it, carried *Cloaths*, built a *Hut* to keep them from the Rain and Sun, and both preſently by *drinking* and *bathing* found ſuch Eaſe, that in about ten Days they returned perfectly cured. It comes out of a Rock in a freſh *Current*, near to a fine Rivulet of good cool Water, but is ſo *hot*, that they all affirm it ſoon boils *Eggs*, ſome ſay *Craw-fiſh*, *Chickens*, and even a *Turkey*; but perhaps this laſt wants good *Confirmation*. However it is certain, that, near where it comes forth, there is no enduring any Part of the Body, but it takes off the Skin. It cures *Ulcers*, and *contracted Nerves* and *Sinews*, in a few Days, to a Miracle. Colonel *Beckford*, who was given over by the *Phyſicians*, with Pains in his Bowels very acute, that had worn him out, and another for the *Venereal Diſeaſe*, and one for the *Belly-Ach*, went up ſince. Col. *Beckford* is finely recovered, and the other almoſt cured of his Ulcers; ſo that the Water is beyond doubt, and many are reſorting to it.

It has been tried with *Galls* in my *Sight*, and it makes the Water only in 24 Hours look only like *Canary*, or *Old Hock*. But we have a fine large River runs by the ſides of this Town, which ſerves all the People for drinking and other Uſes, and was by the *Spaniards* call'd *Rio Cobre*, or the *Copper River*; this now our Curioſity has led us to try with *Galls*, and in one Night the Water turns to a deep Green, more inclining to Black, deeper colour'd than any *Emerald* I ever ſaw; which makes me doubt the *Copper-Mines* in it are not enough digeſted, and that 'tis unwholſome; but were the Copper more refined and excellent, it would be a ſalubrious Water. I have alſo tried ſeveral Water-ſprings and Rivers hereabouts, and find them all ting'd with ſome Metal or other.

By Mr. Rob. Tradway, n.232.p.712

2. We have lately diſcover'd two *Hot Springs* in *Jamaica*; one to *Windward*, which ſeems ſulphurous; the other to *Leeward* is very ſalt, but, as I am told, does not partake of *Brimſtone*; and both very much magnified for the *Epidemick Diſeaſes* of theſe Parts, the *Dry Belly-ache*, Pains of the *Nerves*, and *Yaws*.

Obſervations *concerning* Healing Springs, by Dr. J. Beal. n.57.p.1155

XLII. Tho' the Particles of *Water* are ſo minute, that we cannot diſcern them with our Eyes, yet by *feeling* we may diſtinguiſh the acute and vigorous Particles of *healing Waters*, from the languid and hurtful Particles of common *Waters*. The *healing Water* will intermingle with their Aſperities ſuch an agreeable *Titillation*, as will invite us to rub in, or preſs on the cleanſing and terſive Water; and will all along recompenſe the Pain of ſearching the Wound by their active Frictions with ſuch ſpeedy Reparations, and ſuch indulgent Degrees of *Sanation*, as mitigates the Torment with Store and Variety of Pleaſures. Other common Waters, even thoſe of ſome of the pureſt and almoſt cryſtalline Fountains, are moſt poiſonous; encreaſing *Tetters*, and fomenting *Ulcers*, with an inward and ſullen Painfulneſs. This dextrous Water, by a moſt favourable *Chirurgery*, ſearches to the *bottom* of *old* and *cancerous Ulcers*, ſweeps or ſhaves away the Roots of *Tetters* and *Cancers*, and appeaſeth the unnatural *Rage*; and ſome of theſe *healing Waters* are benign, whether we apply them outwardly, or truſt them inwardly for the Relief of our *Entrails* and *Vitals*. And by theſe remarkable *Indications*, and the Effects I have ſeen ſucceeding, I have been confirmed of the real Virtue of ſome of the (ſo call'd) *Holy Wells*, of oldeſt Reputation in *England*, and have diſcovered other *healing Springs*, whoſe Virtues were not much known, or noted before.

Our *Eyes* alſo may be in ſome Senſe good Witneſſes of peculiar *Figures* in the *Particles* of thoſe *Spring Waters* which are proper for the *Eyes*. They ſeem to ſcour the *Eyes*, as it were with ſharp but very fine *Gravel*. And by this *Indication* I have tried and found the Springs, which are extraordinary for the Eyes, and perhaps to cleanſe *Optick Glaſſes*. About 30 Years ago, in a very *hot* and *droughty* Summer, there was an *Epidemical Diſtemper* of Mens *Eyes* and *Eye-lids*; I found it ſo at *London* and *Weſtminſter*, and almoſt in every Houſe where I came, as I travell'd Weſtward on both ſides *Severn*; *Verjuice*, or the Juice of *Crabs*, was found the beſt Remedy; and where they knew it not I gave notice of it; and all that try'd it, confeſs'd that it was not a very unpleaſant *Application.* Their *Eyes* had a fretting *Itch*, and *Verjuice* prov'd more agreeable than *Vinegar* or *White Wine*, or any other Liquor or Mixture. Some ſuch tickling Pleaſure, but yet more delicate and tender, there is in ſome *Spring-waters*, which are for the *Eyes* peculiar.

The *Springineſs* of *Wool*, more than of *Linen*, offers another viſible and tangible Demonſtration, how the ſtronger and quicker *Springs* of ſome Water, more than of other, may conduce more or leſs to healing; or may be more or leſs noxious, either inwardly taken or outwardly applied.

I knew one, who was ſhot in his Heel with an Arrow, which carried with it a very ſmall Rag of the *woollen Stocking:* This Rag not being found by the *Chirurgeons*, tho' they were then of the beſt Note, the Wound became for a Year or two incurable; and the Pain was ſo intolerable, that it was thought neceſſary to cut off his Foot. At laſt by chance the Rag was found, and taken away, and then the Cure was ſoon perfected. *Woollen* and *Linen* may have their Turns and Seaſons; the one as a *Mechanical Operation* for *healing* by a cloſe and permanent *Friction*, the other as a quiet *Lenitive*. Our tender Skin can hardly bear the inceſſant *Springineſs* of *Wool*; in a deep Wound we can leſs endure it. But the Springs of ſome Waters may be lined with a ſofter Liquor than the hairy curled Filaments of *Wool*; and hence we may perceive how ſome Waters may by their rolling Particles be the greateſt *Probes*, and yet the ſureſt Searchers, Cleanſers, and Healers. And hence alſo, on the contrary, we may ſee how ſome Waters, which cure *Ulcers* and *Cancers* by outward Application, may be too buſily corroſive and dangerous, if taken inwardly.

I think I may note, that generally all the Springs in *England* that are of very antient Eſteem for Healing, and were commonly call'd *Holy-Wells*, (ſuch as *St. Winifred's Well* in *Flintſhire*, of which I never made Trial, but it carries the greateſt Fame) are all very pure, and yield no kind of *Sediment*. In this our *Hot-Baths*, and perhaps ſome few mineral Springs, are to be excepted. I muſt yet be more particular.

I know a *Spring*, which the Old People there call the *Holy-Well*, on the ſide of a low Hill, in an arable Field, which (beſides the *healing Qualities*) hath an extraordinary Efficacy in clearing the *Skin* from *Sun-burnings* and *Freckles*; and addeth as much Luſtre as agrees with the finer Art of concealing Art, and with Modeſty; and after waſhing 2 or 3 Mornings it makes the Skin as ſmooth as Glaſs. It paſſeth thro' a Vein of light *Sand*, if I may call it *Sand*; 'tis more like to ſome kind of bluiſh criſped *Marle*; 'tis ſo light and hollow, as it were freſhly working by ſome Ferment; and 'tis full of very ſmall and thin *Laminæ*, ſeeming to be *metalline* and *bright* like the pureſt *Silver*, but the *Refiners* could not find it to be of any *Value*. I was inquiſitive to ſearch it out, whether this *Water* had the *beautifying Property* from the Silver-like *Laminæ*, or rather gave thoſe Veins of the *Earth* that *Tincture* and *Ferment*. Only two things I can affirm: 1. I ſaw many Springs opened in the lower Grounds, which ſeemed in all appearance to run from the ſame Head, and had alſo the ſame very bright Ferment in their Paſſages where they were opened, but theſe had nothing of the ſame Property for

Healing or for *Beautifying*; as I found by many Trials, more than daily, for ſome Years together. 2. The common Fields adjoining had on their Clods and Fallows ſomewhat of the ſame Glittering, much faded, but enough to dazzle their Eyes that fixed them on it in a bright *Sun-ſhining*. May not ſome *ſubterranean Steam* give the *Tincture* both to that Vein of Earth thro' which it paſſed more freely, and alſo more forcibly to that Spring, by a greater Reſort, or by ſome Advantage it got by the *Aſcent* of the Ground? (And we commonly find theſe *healing Springs* either near the Top, or on the Side, or near the Foot of ſome Hill, or running from the Hill:) And thus the *Steams* reverberated and daſhed down by the Motion of the Air, and by the *Weight* of the Atmoſphere, may beget the ſame *metalline Tincture* in the adjacent Fields. This was far enough from yielding Sediment, and it had a pleaſing Smoothneſs, and was very inoffenſive to the Stomach; but it ſearched the Eyes ſomewhat ſmartly, and cleared them ſpeedily, and was generally commended for many *Healings* both inwardly and outwardly, and was every way much more pleaſing than tormenting.

Within two Miles of the ſame is another of their old *Holy-Wells*, on the Brow of ſuch another Hill, in an arable Field, within half a Mile of the lofty *Malvern-Hill*: This is very kind for the Eyes, and hath alſo done many Cures upon putrid and fœtid Ulcers, which were many Years deplorable for incurable, as I can affirm upon my own Knowledge. I have ſeen it tried often, and always to good Effect; ſometimes conſiderably wonderful. *Vid. ſup.* §. xxiv. 4.

Many drink of it, and much extol it for Healings: And I never could hear of any that complained of hurt done by it. It was ſomewhat aſperous, but pleaſing in malignant Ulcers.

But much greater is the Reputation of the *Holy-Wells*, as they call them, on the ſide of *Malvern-Hills*; which Hills divide *Worceſterſhire* from *Herefordſhire*. The higher Spring is peculiar for the Eyes: About a Furlong lower is the *healing Spring*; this cureth many Maladies and Cancers, if applied before the Strength of Nature be overthrown. I have read in the Monuments belonging to the *Hoſpital* at *Ledbury*, a Town in the Way from *Hereford* to thoſe Springs, that a Biſhop ſome Ages paſt endowed that Hoſpital with Revenues for the Entertainment of diſtreſſed Paſſengers that travelled to thoſe Springs for Relief. Above 50 Years ſince I heard a panick Story ſpread all over the City and Country of *Worceſter*, that the *Phyſicians* had poiſon'd thoſe Wells. But I am perſuaded, that the ground of this Fable was only this: After more than ordinary Rain, for 1, 2, or 3 Years together (as it falls ſometimes in *England*) ſome *common Waters*, by a part of the ſame or ſome other Channel, do drive to the ſame Aperture, and drown the Excellency of the *Healing-Water*. In this droughty Year (1669) we find, that many excellent Springs have loſt more than half, and ſome more than 4 Parts of 5 of the Waters which they did uſually afford in the ſame Seaſons of the other moiſter Years; and the remaining *Waters* have the ſtronger Efficacy. Of this *Expectation* from long Droughts I formerly advertis'd you. And 'tis now *remarkable*, that the better *Springs*, which are on the ſide of the Hills and on the higher Ground, do maintain their *Current* much better than thoſe which

are

are in the lower Vale. 'Tis ſo in many Places about us here, when the better Springs had loſt 4 Parts of their Current, many of the lower Springs were quite dried up. All theſe Waters are purely limpid, free from all Sediment, very terſive and ſearching, moſt effectual at the *Spring-head*.

I omit many other *healing Waters*, that I may give you a brief Touch of ſuch *mineral*, *ſaline*, and *medicinal Waters*, as I have found or heard of in our Neighbourhood, namely about *Yeovil* in *Somerſetſhire*. I lately heard of two more *metalline Springs* in *Dorſetſhire*, beſides that of *Farrington*; perhaps their Virtues and their Fame are increaſed by this Drought. The *ſaline Spring*, mentioned by Dr. *Highmore* to be at *Eaſt-Chenock*, is about 3 Miles hence Weſtward. In a very droughty Summer I found it *ſtrong Brine*. But there is a *Salt-Spring* of a far greater Worth at *Everich*, about 12 Miles hence towards *Shepton-Mallet*. The Pool, which yieldeth *vitriolate Salt*, is in *Sock-Dennis*, 3 or 4 Miles from hence Weſtward. 'Tis not a great Pool, nor above ten Foot ſquare. Whether the Salt proceedeth from a Spring, or from a Vein of *vitriolate Earth*, I cannot yet determine; but the Mud and Earth about it is as blue as any *Roman Vitriol*. In a long laſting and hard Froſt I ſent for a Quart Bottle of the *Water*, and found it very thick and blackiſh, and it ſcented intolerably ſtrong, not much unlike Gunpowder newly inflamed. Cloſe adjoining unto this Town of *Yeovil* were two Springs kind for the Eyes; the one in a Paſture, the other within a Bolt-ſhot in a Field.

Vid. inf. § XLIV. 2.

Vid. ſup. § XXX. 3.

The old People prefer that in the Paſture before the other, as they have it from elder Tradition, and their pretended Experience. And at this time the more commended Spring, which is in the Paſture, and on the ſide of a riſing Ground, runs freely; the other is newly dried up. 'Tis not every ſlight *gravelling* of the *Eyes* that ſufficiently indicates an extraordinary *Eye-water*; many good Springs have a degree of *Terſiveneſs*; but that which is extraordinary hath a Fiction ſomewhat permanent, and is in the End gratifying. We have alſo, cloſe by our Town, a Spring called *Ruſty-well*; where it breaks out, and where it firſt falls, it tingeth the Stones of the Colour of *Ruſty Iron*, and it hath the Smell ſtrongly, and ſeemeth to taſte of *Ruſty Iron*, yet is as clear as any Water; and I tried it for a Month or more in my Study, putting *Corniſh-ſlate* and Pebbles to it in a Glaſs, and it gave no Tincture at all to the Stones, nor any Sediment; ſo that I ſuſpect the Tincture to proceed from ſome Effluvium mingled with the Water at firſt opening; but I confide not much in the ſingle and ſhort Trial I made. Some old Men boaſt of many great Cures it hath done.

Our Fore-fathers and very old Men ſcarce heard of the Name of the Scorbute; 'tis a ſeaſonable Providence, if, ſince that Diſeaſe is become ſo Epidemical, the Remedy ſhould be ſo obvious and vulgar, as is pretended to be by ſuch ferruginous Springs.

This breaks out near the foot of a lofty Hill, which continues, with ſome leſſer Falls, about 3 Miles Weſtward to *Hamden-Quarry*, where they dig a hard Free-ſtone of a dark yellow Colour. At *Weſt-Camel*, 5 Miles hence Northward, is a very fœtid black Spring, which tingeth Silver black immediately; and I am told, that about 10 Miles hence, more Eaſtward, near

Wine-Caunton, not many Years ago, they digged for *Coal*, where the Coal-Men were endangered by a *Fœtid Damp*: And when they aſſayed the Coal in the Fire it proved very noiſom, ſo that they forſook thoſe Coal-Mines. Perhaps it may be ſerviceable to them that know not how to make an honeſt Uſe of *Arſenic* and other *Poiſons*.

Here again, with ſome Timorouſneſs, I propoſe the Inquiry, whether *ſubterraneous Steams* might not give the *dark yellow Tincture* to the *Hamden-Quarry*, and the Property to this Water of *Ruſty-well* for the *Pulvous Colouration?* It cannot be expected, that Materials, differing ſo much as Stones ſeem to differ from *Water*, when perfectly petrified, ſhould retain the very ſame Colour, though both received it from the very ſame *Steams*. The ſame I propoſe for the Blackneſs and Fœtidneſs of the Spring in *Weſt-Camel*, and of the Coal near *Wine-Caunton*; that both may receive the ſame *Tincture* and *Odour* from *ſubterranean Steams*, which may perhaps be of ſo many Kinds and Mixtures, as to cauſe much of the great Diverſities of *Metals*, *Minerals*, *Earths*, and *Soils*; and of ſome minute Differences in the *Colour*, *Taſte*, *Odour*, and *Dreſs* of *Vegetables*; yea, and of the *Furrs*, *Hairs*, *Wooll*, and other little Varieties in *Animals* (particularly in *Sheep*) in ſeveral Places; more immediately in *Vegetables*, and of *Animals* by remoter Circumſtances; I will not except the *Ethiopick Hue*, and *Humours* of Men in *diſtant Climates*, though *Vegetables* and *Animals* do, for the moſt part, retain their *ſeminal Properties* in *diſtant Climates* for many Generations. And perhaps from theſe *Terreſtrial Steams* the *Vegetables* do imperceptibly draw ſome of their *Salts*, and much of their *Nutriment*.

For theſe *Overtures* I will at preſent inſtance no more than thus. The illuſtrious Mr. *Boyle* hath, methinks, evinced, that the moſt ſolid Bodies, we know, have their *Atmoſpheres* of *Steams* and *Exhalations*: And whatever the Materials be, which are under our *Terrene-Cruſt* towards the Center, whether fluid, flaming, or groſs Subſtances, they muſt needs hold an Intercourſe of *Tranſpirations*, and mutually operate by their perpetual Agitations and Whirlings about: And by the *Vulcano*'s, frequent in *Japan*, and in ſeveral other Places, and by the *Heats* in deepeſt Mines, and by many other manifeſt Arguments, it appears, that there are always ſtrong *Steams* aſcending towards the Surface of the Earth: And, if their *generative Power* and other Efficacies were duly examined, and proſecuted to the beſt Purpoſes, we might perhaps in time find them to have a greater Virtue, and more uſeful for us, than many of the *Conſtellations* and *Celeſtial Influences*, which make no ſmall Noiſe amongſt *Aſtrologers*.

XLIII. Viſiting the famous *boiling Fountain* at *Peroul*, not far from *Montpelier*, I found the Water to heave, and boil up very furiouſly in ſmall Bubbles; which manifeſtly proceeded from a Vapour breaking out of the *Earth*; for upon digging any where near the Ditch, and pouring other *Water* upon the dry place newly dug, I obſerved in it immediately the ſame *boiling*, as the exquiſite Naturaliſt Mr. *Ray* has related in his Travels. The like bubbling of Water is alſo found round about *Peroul*, upon the Sea-ſhore; and in the *Etang* itſelf. But when I had taken ſome of the Sand and Earth out

Obſervations on boiling Fountains, *and* ſubterraneous Streams; *by Dr.* Tancred Robinſon. n. 169. p. 922. n. 172. p. 1038.

of the Fountain and Ditch, and put it into Veſſels, pouring the ſame Water upon it, there did not appear the leaſt *Perturbation* or Alteration thereupon; the Superficies of the *Water* continuing very ſmooth, equal, and quiet. And for further Satisfaction I ſought out, and diſcovered in ſeveral dry Places of the Ground thereabouts, many little *Ventiducts*, Paſſages or Clefts, where the Steam iſſued forth; at the Mouths of theſe Channels or Pipes, placing ſome light Bodies, as *Feathers*, ſmall thin Pieces of Straws, Leaves, &c. I found them ſoon removed away. This Vapour, upon the Application of a lighted Candle or Torch, did not flame, or catch the leaſt n. 172. p. 1038. Fire; as the Fumes running through a boiling Spring near *Wigan* in *Lancaſhire* do; with which thoſe burning Fountains near *Grenoble* in *Dauphine*, near *Cibinium* or *Hermanſtadt* in *Tranſylvania*, near *Chermay*, a Village in n.169.p.923 *Switzerland* in the Canton of *Friburgh*, and that not far from *Cracovia* in *Poland*, do agree in many Particulars. Many *hiſſing* Springs, bubbling at the Top, I have found in *Switzerland* (the beſt watered Country that ever I ſaw) and in many Places near the *Rhine*. The like is related by *Varenius* near *Culma*, and by Dr. *Plot* in *England*. There are other *boiling Waters* of a quite contrary Temper, being actually *Hot* to ſeveral Degrees, ſo as to boil Eggs, and many other Things put into them; as thoſe near the *Solfatara* not far from *Naples*; as alſo upon the Top of Mount *Zebio* in the Duke of *Modena*'s Territories, not far from his *Villa* near *Saſſalo*; in the Source of the *Emperor*'s Bath at *Aken*, in the Country of *Juliers*; and in *Japonia*, mentioned by *Varenius*.

From the foregoing Hiſtory we may take occaſion to reflect a little upon the manifold Variety of *Exhalations*, prepared in and flying out from the vaſt *Magazines* and ſeveral *Reconditories* below, as to their Qualities and Effects; ſome being *cold* and *dry*, reſembling Air or Wind; as thoſe near *Peroul*, and in the *Caverns* of Mountains, eſpecially thoſe of *Æolus* and other Hills of *Italy*; as alſo in Mines upon the meeting of *Water*. Others are *inflammable*, and of a *bituminous* Nature, tho' not actually *warm*; as thoſe near *Wigan* in *Lancaſhire*. There are alſo many *Steams* very *Hot*, *Sulphurous*, and *Saline*; more eſpecially thoſe in the natural *Stoves*, *Sweating-vaults*, *Grottos*, *Baths*, and the *Volcanos* near *Naples*, *Bajæ*, *Cuma*, and *Puzzuolo*; as alſo in ſome of the *ſubterraneous Works* at *Rome*. Others there are of an *Arſenical*, and ſuch like venomous Qualities; as in the *Grotto del Cano* on the Bank of the *Lago Agrano*, in many Mines, in poiſonous Springs and Lakes.

Now theſe various Steams, meeting with and running thro' *Waters*, muſt cauſe a great Variety of *Phænomena* and Effects in them. Whether this great Diverſity proceeds from the various *Breaths* of the *Pyrites*, and the *Lapis Calcarius*, n. 172. p. 1039. Vid. Inf. Cap. III.] whilſt under their different States and Changes, or from other ſorts of *Effluviums*, I dare not determine: But I am apt to believe that there may be Veins of the *Pyrites* near thoſe *Places*; the *Inflammibility* of which *Mineral* hath already been diſcourſed of, and made very clear by Dr. *Liſter*.

An ingenious Author, relating the Hiſtory of a burning Fountain in the *Palatinate* of *Cracovia*, affirms that upon *evaporating* the Water a dark, or Pitch-like Subſtance may be extracted, which cures the moſt *inveterate Ulcers* *ters* in a very ſhort Time; and that the Mud itſelf is very powerful againſt *Rheumatick* and *Gouty Pains*, *Palſies*, *Scabs*, *&c.* The Inhabitants of an adjacent Village, who drink much of this Spring, do generally live to 100 or 150 Years, which he attributes to the ſanative Virtue of the *Water*.

The *Naptha*, or *Bituminous* Subſtance floating upon a Spring at *Pitchford* in *Shropſhire*, and upon *St. Catharine*'s *Fountain* near *Edinburgh*, had been ſucceſsfully uſed in *Ulcerous* and *Cutaneous* Diſtempers. Many ſuch like Fountains of *Petroleum*, and *Oily Subſtances*, are to be met with up and down; as in the Iſland of *Zant* very plentifully; near *Gabian*, in the Road from *Montpelier* to *Beziers* in *Languedock*; in the *Valteline*, ſubject to the *Griſons*; at the Foot of Mount *Zebio*, in the Dutchy of *Modena*: Not to mention any of the Places written of already by *Varenius*. The Inhabitants, living near theſe Fat Oily Springs, take great care to gather and ſeparate the *Bituminous Subſtance* from the *Water*, making very conſiderable Advantages of them, for *Mechanical* and *Medicinal* Uſes, I have ſeen them gather it up with Ladles, and put it into large Filtres, or into great Funnels ſtopp'd at the *Bottom*; or elſe into Barrels ſet on one End, which have Spiggots near their Bottoms; when they are full, and have ſtood a while, they open the Spiggot or Stoppel to let out the *Water*; and, when the Oil or *Bituminous Subſtance* begins to come, they preſently ſtop it again.

Salt-Springs *at* Hall *in* Saxony, *and at* Lunenburgh; *by*... n. 8. p. 136.

XLIV. 1. The Salt Springs at *Hall* in *Saxony* are Four; called *Gutiaar*, the *Dutch Springs*, the *Wettritz*, and the *Hackel-dorn*. The three *Firſt* hold above 7 Parts of *Salt*, 3 of *Marcaſites*, and 14 of *Water*. The laſt holds leſs, but yields the pureſt Salt.

They are (beſides their Œconomical Uſe) employed medicinally to bath in; and to draw a Spirit out of it, exhibited with good Succeſs againſt *Venom*, and the *Putrefaction* of the *Lungs*, *Liver*, *Reins*, and *Spleen*.

The Salt-Water at *Lunenburg*, being more greeniſh than white, and not very *Tranſparent*, is about the ſame Nature, and holds with that of *Hall*. It hath a Mixture of Lead with it, whence alſo it will not be ſod in Lead Pans; and, if it held no Lead at all, it would not be ſo good, that Metal being judged to purify the Water; whence all the Salt of *Lunenburgh*, is preferred before all others that are made of Salt Springs.

In Somerſetſhire, *by Dr.* Highmore, n. 56. p. 1130

2. I made *Trial* of that Salt-Spring at *Eaſt-Chenock* in *Somerſetſhire* (above 20 Miles from the Sea) which tho' not ſo *ſalt*, by reaſon of the late *Rains*, as in *Summer*, yet from a *Wine-Quart*, by *Evaporation*, yielded near 80 *Grains*.

In the Biſhoprick *of* Durham, *by Mr.* Hugh Tod, n. 163, p. 726.

3. At *Salt-Water-Haugh* near *Butterby*, about a Mile and a half from *Durham*, in the middle of the River *Weare*, riſes a Salt-Spring. It is good to be ſeen and taſted only in the Summer-time, when the Water is diſcharged all on one ſide of the Channel; for in Winter, when the River is high, it loſes its Salt in the freſh Streams, ſo that they are not perceivable. The Water ſeems to bubble up equally in all Parts in the Channel, for the Space of 40 Yards in Length, and about 10 in Breadth. The ſalteſt of all the Springs iſſues out of the middle of a Rock, the Surface of which was manifeſtly ſaltiſh; and which, in a hot Day, as I was told, would be all covered over with a perfect Salt. I had all the Water laved out of the Place

where it ſeemed to ſtagnate, and immediately out of the Body of the Rock there bubbled up Water as ſalt as the former. It was as high as any Brine can be, and tho' but little in Quantity, in Compariſon of the freſh River, yet of that Force to give a Brackiſhneſs to the Streams a hundred Yards below. Thoſe that have boil'd this Brine ſay, that it affords a great Quantity of Bay Salt, not ſo palatable, yet as uſeful as ordinary Salt is. It *tinges* all the Stones with a red Colour. The Sea is eight Miles off, where neareſt.

Salt-ſprings *and* Salt-Making *at* Nantwich *in* Cheſhire, *by* *Dr.* Will. Jackſon, n. 53. p. 1060. n. 55. p. 1122. n. 54. p. 1077

XLV. The Depth of the Salt-ſprings is in ſome Places not above 3 or 4 Yards: In *Nantwich* the Pit is full 7 Yards from the footing above the Pit; which is gueſſed to be the natural Height of the Ground, though the Bank be 6 Foot higher, accidentally raiſed by Rubbiſh of long making Salt, or Walling, as they call it. In two Places within our Townſhip the Springs break up ſo in the Meadows, as to fret away not only the Graſs, but part of the *Turf* of the Meadow; and hath a ſalt Liquor ouſing as it were out of the Mud, but very gently.

Our Country is generally a low Ground, witneſs the Name given to it, the *Vale Royal* of *England*; yet it is very full of collicular Eminencies and various Riſings, to diſtinguiſh it from being all Meadow. The neareſt Hills (of thoſe worth calling Hills) is about 7 Miles diſtant from the Springs; it is ſteeper but not much higher than *Highgate-Hill.*

We have alſo a peculiar ſort of Ground in this County and ſome adjacent Parts, which we call *Moſſes:* And they are a kind of mooriſh boggy Ground, very ſtringy and fat; which ſerveth us very well for *Turfs*, cut out like great Bricks, and dried in the Sun. And this kind of Ground is ſo much here, that there are few *Townſhips* but they have their particular *Moſſes*. In theſe is found much of that Wood we call *Firr-Wood*, which ſerves the Country-People for Candles, Fewel, and ſometimes for ſmall *Timber-Uſes*; and this the Vulgar concludes to have lain there ſince the *Flood.* But generally theſe *Moſſes* ſeem to be Places undermined by ſome *ſubterraneous Streams*; or by the Diſſolution of ſome Matter, that made them equal with the reſt of the Ground formerly: In which Conjecture I am confirmed by this, that near a Place of my Lord *Cholmondeley's*, called *Bilkely*, about 9 or 10 Years ſince, not far from one of theſe *Moſſes*, without any Earthquake, a Piece of Ground, of about 30 Yards over, fell in with an huge Noiſe, and great *Oaks* growing on it fell in with it together; which hung firſt with Part of their Heads out, afterwards ſuddenly ſunk down into the Grounds, ſo as to become inviſible: Out of which Pit they drew Brine with a Pitcher tied to a Cart-rope, but could then find no *Bottom* with the Ropes they had there: The Pit is ſince filled up with Water, and now doth not *taſte* ſalt, but a very little brackiſh, a very ſmall Rivulet paſſing through it. The neareſt Salt-ſprings to this Place are at *Durtwich* about three Miles from it.

Our Springs are about 30 Miles from the Sea; and generally lie all along the River *Weever:* Yet there is an appearance of the ſame *Vein* at *Middlewich*, nearer the River *Dane* than *Weever*; which notwithſtanding ſeems not to be out of the Line of the *Weever's Stream*; and theſe lie all near Brooks and in the meadowiſh Grounds.

I could obſerve no Singularity at all in the Plants; for, where the Salt reaches the Surface, it frets away all, as I ſaid before; and upon the *Turf*, near the old decayed Pits, grows the very ſame that doth in the remoteſt Place of the Meadow; only I obſerve, that where the *Turf* was fretted away Ruſhes maintained their Station longeſt.

The Water is ſo very cold at the Bottom of the Pit, that when the Briners ſometimes go about to cleanſe the Pit, they cannot abide in above half an Hour, and in that time they drink much ſtrong Water. There is not any hot Springs (that I can hear of) nearer us than *Buckſton-well*, which is about 30 Miles diſtant.

Several new Brine Springs have been of late both ſought and found; yet none knows of any Shells, but rather a blackiſh Slutch mixt with the Sand, which infects the whole Spring (like the *Scuttle Fiſh*) black when 'tis ſtirred; elſe the Water runs very clear.

The Springs are rich or poor in a double Senſe; for a Spring may be rich in Salt, but poor in the Quantity of Brine it affords. Thus they have a rich Brine in their chief Pit at *Middlewich*, which yields a full 4th Part of Salt; yet is it ſo thrifty in its Brine, that the Inhabitants are limited to their Proportions out of it, and their Quantity is ſupplied out of Pits that afford a weaker Brine. Our Pit at *Nantwich* yields about 1 Pound of Salt for 6 Pounds of Brine; but then 'tis always, without any ſenſible Difference, ſo plentiful a Spring, that whereas they ſeldom *Wall*, that *make Salt*, in above 6 Houſes at a time, and there are or ſhould be about 50 *Wich-houſes* in the *Town*; this Pit is judged ſufficient to ſupply them all, without falling much lower than a Yard or two at moſt. And this Advantage would accrue over and above, that ſuch quick Uſe of the Pit extreamly ſtrengthens the Brine, perhaps to a Degree little leſs than that of *Middlewich-Pit*: For, I have tried it my ſelf, that a Quart of Brine, when the Pit had been drawn off 3 or 4 Days to ſupply 5 or 6 *Wich-houſes*, hath yielded an Ounce and an half more of *Salt*, than at any other time when it hath had a Reſt of a Week or thereabouts.

March 8. 1668. I weighed 2 Pounds of diſtill'd Water in a Narrow-mouth'd Glaſs-bottle, that I might take an exact Mark for a Quart. This Bottle, being filled with our Brine to the very ſame Mark, weighed (beſides the *Tare* of the Bottle) 2 Pounds 3 Ounces and 5 Drachms. This was taken up when the *Wich-houſes* began to work, ſo that the Pit was but little drawn. I filled up the Bottle with the ſame Brine, and it weighed juſt 3 Drachms more. This Brine boiled away, without any Addition or Clarification, made 5 Ounces and 4 Drachms of Salt. Five Days after, when the Pit had been drawn all that while for the working of the *Wich-houſes*, viz. *March* 13. the ſame Bottle, fill'd to the Quart Mark aforeſaid with Brine then taken up, weighed, beſides the Bottle, 2 Pounds 4 Ounces and an half: The ſame time, the Bottle filled, as in the former Experiment, weighed juſt 2 Pounds and a half, which is 3 Drachms more than the Quarter Mark before; which boiled into *Salt* made 6 Ounces, 6 Drachms and 2 Scruples: Which exceeds the former Quantity of *Salt*, 1 Ounce 4 Drachms and 2 Scruples, though the Brine exceeded the former in Weight but 4 Drachms.

By which Trial I confuted alſo a Tradition which the Briners have amongſt them, *viz.* that the Brine is ſtrongeſt at the time of the *Spring-Tides*, to wit, at the Full and Change of the Moon. For *March* 8, aforeſaid was only one Day paſt the Full, and then the Brine was weaker than it was the 13th Day, when it was 6 Days paſt the Full. So that I conclude there could be no other Reaſon, than that the much *drawing* makes way for the *Salt-Springs* to come the quicker, and allows the leſs time for the Admiſſion of *Freſh-Springs*. But 'tis obſerved by the Briners, that they make more *Salt* with the ſame Quantity of Brine in dry than in wet *Seaſons*.

Their manner of *working* is this: They have formerly boiled their Brine in 6 *leaden Pans* with Wood-fire; upon which Account they all *claim* their Intereſt in the Pit by the Name of ſo many 6 *Leads Walling*; by which they each know their Proportion; but, in the Memory of many alive, they changed their 6 *Leads* into 4 *Iron Pans*, ſomething better than a *Yard ſquare*, and about 6 Inches deep, ſtill fitting the Content of theſe to that of the 6 *Leads*: And of late many have changed the 4 *Iron Pans* into two greater; and ſome *Wall* but in one; but ſtill the Rulers gage it to their old Proportions.

They uſe for their *Fewel* Pit-Coals, brought out of *Staffordſhire*. Theſe *Pans* are ſet upon *Iron Bars*, and made in on all Sides very cloſe (that the *Flame* nor *Smoak* break through) with *Clay* and *Bricks*. They firſt fill their *Pans* with Brine out of the *Pit*, which comes to them in ſeveral *wooden Gutters*; then they put into their *Pans*, amongſt their Brine, a certain Mixture, made of about 20 Gallons of Brine, and 2 Quarts of *Calves*, *Cows*, or chiefly *Sheep's* Blood, mixt into a *Claret* Colour: Of this Mixture they put about 2 *Quarts* into a *Pan* that holds about 360 *Quarts* of Brine; this bloody Brine at the firſt boiling of the *Pan* brings up a *Scum*, which they are careful to take off with a Skimmer, made with a *wooden Handle* thruſt through a long Square of *Wainſcot Board*, twice as big as a good ſquare *Trencher*: This they call Fig. 63. a *Loot*. Here they continue their Fire, as quick as they can, till half the Brine be waſted; and this they call *Boiling upon the freſh*. But, when 'tis half boiled away, they fill their *Pans* again with new Brine out of the Ship (ſo they call a great *Ciſtern* by their *Pan's* Sides, into which their Brine runs through the wooden Gutters from the Pump, that ſtands in the Pit;) then they put into the *Pan* 2 *Quarts* of the Mixture following: They take a *Quart of Whites* of *Eggs*, beat them thoroughly with as much Brine, till they are well broken; then mix them with 20 *Gallons* of Brine, as before was done with the Blood; and thus that which they call the *Whites* is made. As ſoon as this is in, they boil ſharply, till the *ſecond Scum* ariſe; then they ſcum it off as before, and boil very gently till it corn; to procure which, when Part of the Brine is waſted, they put into each *Pan*, of the Content aforeſaid, about a *Quarter* of a *Pint* of the beſt and ſtrongeſt *Ale* they can get; this makes a momentary *Ebullition*, which is ſoon over; and then they abate their Fires, yet not ſo, but that they keep it boiling all over; though gently; for the Workmen ſay, that if they boil faſt here (which they call *boiling on the Leach*, becauſe they uſually all this time lade in their *Leach-brine*, which is ſuch Brine as runs from their *Salt*, when it is taken up before it hardens) if, I ſay, they boil faſt here, it waſtes their *Salt*; after all their *Leach-brine* is in, they boil gently till a kind of Scum comes on it like a thin Ice; which is the firſt Appearance of the *Salt*: Then that ſinks, and the *Brine* every where gathers into *Corns* at the Bottom to it, which they gently rake together with their *Loots*. I ſay gently, for much ſtirring breaks the *Corn*. So they continue till there is but very little Brine left in the *Pan*: Then with their *Loots* they take it up, the Fig. 64. Brine dropping from it, and throw it into their *Barrows*, which are Caſes made with flat cleft Wickers in the Shape almoſt of a Sugar-Loaf, the Bottom uppermoſt, when the *Barrow* is full, they let it ſtand ſo for an Hour and an half in the *Trough*, where it drains out all the *Leach-brine* aboveſaid; then they remove it into their *Hot-Houſe* behind their Works, made there by 2 *Tunnels* under their *Pans*, carried back for that Purpoſe. The *Leach-brine*, that runs from Fig. 65. the Barrows, they put into the next Boiling; for 'tis to their Advantage, it being *Salt* melted, and wanting only hardning.

This work is performed in 2 *Hours* in the ſmaller *Pans*, which are ſhallower, and generally boil their Brine more away; wherefore their *Salt* will laſt better, though it does not *granulate* ſo well, becauſe when the Brine is waſted, the Fire and the Stirring breaks the *Corns*. But this *Salt* weighs heavier, and melts not ſo ſoon, and therefore is bought by them that carry it far. But in the greater *Pans*, which are uſually deeper, they are about half an Hour longer in boiling; but, becauſe they take their *Salt* out of their Brine, and only harden it in their *Hot-Houſe*, it's apter to melt away in a moiſt Air. Yet of this Sort of *Salt* the bigger the *Grain* is, the longer it endures; and generally this is the better *granulated* and the clearer, though the other be the *whiter*. Upon which I rather think, 'tis the taking of the *Salt* out of the Brine before it be waſted, that cauſes the *granulating* of it, than the Ale, to which the Workmen impute it. This Kind meaſures profitably well, therefore it is much bought by them who buy to ſell again.

They never cover their *Pans* at all, during their whole time of boiling. They have their Houſes like Barns open up to the Thatch, with a *Louverhole* or two to vent the Steam of the *Pans*. Poſſibly Tiles may do better, but no Body is yet ſo curious as to try; but the Steam is ſuch, that I am confident no Plaiſter will ſtick, and the Board will warp, and their Nails will ruſt ſo, as quickly to fret in Pieces.

With our *Salt* both *Beef* and *Bacon* is very well preſerved ſweet and good a whole Year together; and I do apprehend this *Salt* to be rather more ſearching than *French Salt*, becauſe I have often obſerved, that Meat kept with this *Salt* ſhall be more fiery *Salt* to the midſt of it, than I have obſerved when I have eaten powder'd Meat on Ship-board, which was probably done with *French Salt*; I then being on the South-ſide of *England*, and in a *Dutch* Veſſel. 'Tis certain *Cheſhire* ſends yearly much *Bacon* to *London*, which yet had never any Mark of Infamy ſet upon it; and hang'd Beef (which others call *Martinmaſs-beef)* is as good and as frequent in *Cheſhire* as in any Place; ſo that I conclude that this laſt is fully effectual for any uſe, and as good as any other.

The Sweepings of ſuch *Salt* is conſtantly ſhed and ſcattered about on the Floor, not without taking much of the Dirt (which occaſions its *Greyneſs*) and is called *Grey Salt*. This ſells not at half the Rate of *White Salt*, and is only bought up by the poorer ſort of People, and ſerves them in ſalting *Bacon*, coarſe *Cheeſe*, *&c.* *Cats* of *Salt* are only made of the worſt of *Salt*, when yet wettiſh from the *Pans*; molded and intermixt with interſperſed *Cummin-Seed* and *Aſhes*, and ſo baked into a hard Lump in the Mouths of their Ovens. The Uſe of theſe is only for *Pigeon-houſes*. But *Loaves* of *Salt* are the fineſt of all for Trencher Uſe. There is no Difference in the boiling of theſe from the common way of the fine Salt; but in the making up ſome Care is uſed: For firſt they cut their Barrows, they intend for *Salt-Loaves*, with a long Slit from Top to Bottom equally on both Sides; then they tie both Sides together with Cords; then they fill this Barrow with *Salt* boiled as uſually, but in the filling are careful to ramm down the *Salt* with the End of ſome wooden Bar, continuing this till the Barrow be fill'd to their Minds; then placing it ſpeedily in their *Hot-houſe*, there let it ſtand all the time of their *Walling*: Wherefore they prepare for their *Loaves* at the Beginning of their Work, that they may have all the Benefit of their *Hot-houſes*; and, when theſe begin to ſlack, they take out the *Loaves*, and untie the Cords that faſtened the Barrow, that both Sides of the ſame may eaſily open without breaking the Loaf. They then take the Loaf and bake it in an Oven where Houſhold-Bread hath been baked, but new drawn forth. This they do twice or thrice, 'till they ſee it baked firm enough; and this being placed in a Stove or in a Chimney-Corner, and cloſe covered with an Hoſe of Cloth or Leather, like the Sugar-Loaf-Papers, will keep very white; and when they have occaſion to uſe any, they ſhave it off with a Knife (as you do Loaf-Sugar) to fill the Salt-ſeller.

Explication of the Figures.

Fig. 63. The Loot.

Fig. 64. *aa*, Two *Barrows* filled with *Salt*. *bb*, The Salt heaped above the Top of the Barrows, and patted down hard. *C*, The *Leach-Trough*.

Fig. 65. *aaaaaa*, The *Hot-houſe* between the Wall and the Chimney. *bb*, two *Tunnels*. *CC*, The Chimney-back, into which the *Tunnels* convey the Smoak. *dddd*, The 4 *Pans*. *E*, The Partition-Wall between the *Pans* and the *Hot-houſe*. *ff*, The *Fire-places*. *gg*, *Aſh-holes*. *hh*, The *Hearth* below. *ii*, The *Deſcent* to the *Hearth*.

At Droitwich *in* Worceſterſhire; *by Dr.* Tho. Raſtel. n. 142. p. 1059.

The Country is neither *Plain*, neither hath it any great *Hills*, but many ſmall Riſings; the greateſt Hills near us being the *Lickie* within 6 Miles, which ſome call *Look-high*, ſuppoſing it to be the higheſt Ground in theſe Parts, becauſe the Springs which riſe there run into the North and South Seas; near to which are *Clent-Hills*, about the ſame Diſtance. On the other Side the River *Severn* are *Aberly* Hills, at about 7 Miles Diſtance from us. There are many Salt-ſprings about the Town, which is ſeated by a Brook-ſide, called *Salwarp-brook*, which ariſe both in the *Brook*, and in the Ground near it, tho' there are but 3 Pits that are made uſe of.

Where the Springs are ſalteſt there grows nothing at all, but by the *Brackiſh* Ditches there grows *Aſter Atticus* with a pale Flower, which I find no where elſe with us.

Some of the *Salt-ſprings* riſe on the Top of the Ground, which are not ſo *ſalt* as others. The great *Pit*, which is call'd *Upwich-Pit*, is 3 Foot deep, in which are 3 diſtinct Springs riſing in the Bottom; one comes into the Pit North-weſt, another North-eaſt, the 3d South-eaſt, which is the richeſt both in Quantity and in Quality. They all differ in Saltneſs, which I can give no exact Account of, it being impoſſible ſo to ſeparate them, that there ſhall be no Mixture; the Pit is about 10 Foot ſquare; the Sides are made with ſquare Elms jointed in at the full Length, which I ſuppoſe is occaſioned by the *Saltneſs* of the Ground that appears to me to have been a *Bog*; the Surface of it is made of Aſhes. That it was originally a *Bog*, I am induced to believe, for not many Years ſince, digging to try the Foundation of a *Seal*, for ſo we call our Houſes we make Salt in) I thruſt a long Staff over Head.

Tho' the *Brine* be colder than the other Water, yet it never freezeth; but the Rain Water, that lies upon the Brine, in extream hard Froſts will freeze, but not much.

The *Soil* about the Town, on the lower Side of it, is a black rich Earth, under which 2 or 3 Foot is a ſtiff gravelly Clay, then Marle. Thoſe that make Wells for freſh Water, if they find Springs in the Marle, they are generally freſh; but if they ſink thro' the Marle, they come to a whitiſh Clay mixed with Gravel, in which the Springs are more or leſs brackiſh.

In the great Pit at *Upwich* we have at one and the ſame time 3 Sorts of *Brine*, which we call by the Names of *Firſt-man*, *Middle-man*, and *Laſt-man*; theſe Sorts are of different *Strengths*; the *Brine* is drawn by Pump; ſo that which is in the Bottom is firſt pumped out, which is that we call *Firſt-man*, *&c.* That I might make an exact Trial of the Strength, I made me a Quart that contained 24 *Ounces Troy* of diſtill'd Water; which Quart being filled with the firſt *Brine*, beſides the Tare of the Quart weighing 29 *Ounces*, made 7 *Ounces* and 3 *Drachms* of *Salt* without any Addition; the next Day I weighed the ſame Salt again, and it weighed 7 *Ounces* and 6 *Drachms*; ſo that 4 *Tuns* of *Brine* make above one Tun of Salt. The ſame Quart filled with *Middle-man*, which is the ſecond ſort of *Brine*, weighed 28 *Ounces*; I alſo weighed a Quart of *Brine* as it came immediately out of the Springs, which weighed 28 *Ounces*, and the 3d ſort 27 *Ounces*; ſo that what the firſt gets, the laſt loſeth, which doth precipitate as much in 24 Hours, as if it ſtood a much longer Time.

The Quantity of *Brine* that this Pit yields every 24 Hours is as much as will make 450 Buſhels of Salt, which is drawn out twice or three times a Day, for ſo oft we ordinarily draw, and that as long as the Pump will go.

In the beſt Pit at *Netherwich* a Quart of *Brine* weighs 28 *Ounces* and an half; this Pit is 18 Foot deep, and 4 Foot broad, and yields as much *Brine* every 24 Hours as makes about 40 Buſhels of Salt; there is but one Spring in the Pit, that comes in 2 Foot and 8 Inches above the Bottom.

The worſt Pit at *Netherwich* is of the ſame Breadth and Depth as the former, a Quart of Brine out of which weigheth 27 *Ounces*, and yields as much *Brine* daily as makes about 30 Buſhels of Salt. In this Pit are 3 Springs;

two in the Bottom, and one about 2 Foot higher. Theſe Pits are within 6 Yards of one another.

Theſe Pits are near the *Brook*; the great Pit on the North Side; and about a Quarter of a Mile lower, the 2 leſſer Pits on the South-ſide.

In the great Pit I found no Variation either in Quality or the Strength of the *Brine*, but the Springs in the other Pits are augmented by much Rain, and yield leſs Salt.

That every Man may know his own Proportion, the Brine is divided into *Phats Wallings*; a *Phat Walling* is divided into 12 *weaker Brines*; and every *weaker Brine* is divided into 8 *Burdens*, every Burden being a Veſſel that contains about 32 Gallons; whereof every one hath 6 Burdens of *Firſt-man*, 6 of *Middle-Man*, and 6 of *Laſt-man*, ſo that every Man hath not only his juſt Proportion in Quantity, but in Quality alſo. This Brine is carried in Coolers to every Man's Seal by 8 ſworn Men, which we call *Maſters* of the *Beachin*, and 4 *Middle-men*, and there put into great Tuns for Uſe.

The Fewel heretofore uſed was all Wood; but, ſince the Wood hath been deſtroyed by the Iron-Works, we uſe almoſt all Pit-coals, which are brought to us by Land 13 or 14 Miles.

The *Phats* we boil our *Brine* in are made of *Lead*, caſt into a flat Plate at 5 Foot and an half long, and 3 Foot over; and then the Sides and Ends beaten up, and a little raiſed in the Middle; which are ſet upon *Brick-work*, which we call *Ovens*; in which is a Grate to make the Fire on, and an Aſh-hole, which we call a *Trunk*: In ſome *Seals* are 6 of theſe *Pans*, in ſome 5, and ſome 4, ſome 3, ſome 2. In each of theſe Pans is boiled at a time as much Brine as makes 3 Pecks of white Salt, which we call a *Lade*, and is laded out of the *Pan* with a *Loot*, and put into Barrows, which are ſet into *Baſtals* over Veſſels we call *Leach-combs*, that the Brine may run from the Salt; which Brine we call *Leach*, with which we dreſs our *Phats*, when the cold Brine they are firſt filled with is ſomething boiled away. In theſe *Baſtals* the Salt ſtands ſtill till it's dry, which is about 4 Hours; then we carry it into *Cribs* which are Houſes boarded on the Bottom and Sides, where 'tis kept till ſold, which is ſometimes half a Year, or 3 Quarters; in which time, if the *Crib* is good, it will not waſte a 12*th* Part, the Salt itſelf being of ſo ſtrong a Body: Whereas in *Cheſhire* they are forced to keep their Salt in Barrows in Stoves to dry it, and make it no faſter than they ſell.

For *clarifying* the *Brine* we uſe nothing but the *Whites* of *Eggs*; of which we take a Quarter of a *White*, and put it into a Gallon or two of Brine; which, being beaten with one's Hand, lathers like Soap; a ſmall Quantity of which *Froth* put into each *Phat* raiſeth all the Scum (ſo that the *White* of an *Egg* will clarify 20 Buſhels of Salt;) by which Means our Salt is as white as any thing can be, neither hath it any ill Savour, as that Salt hath that is clarified with Blood.

For *granulating* it we uſe nothing at all; for the *Brine* is ſo ſtrong of itſelf, that, unleſs it be often ſtirred, it will make Salt as big grain'd as *Bay-Salt*. I have boil'd *Brine* to a *Candy-height*, and it hath produc'd *Clods* of *Salt* as clear as the cleareſt *Allom*; like *Iſle* of *May Salt*; ſo that we are neceſſitated to put a ſmall Quantity of *Roſin* into the *Brine*, to make the Grain of the *Salt* ſmall.

Beſides the *White-Salt* we have another Sort that we call *Clod-Salt*, which grows to the Bottom of the *Phats*; that after the *White-Salt* is laded out, is digged up with a Picker, which is made like a *Maſon's Trowel*, pointed with Steel, and put upon a ſhort Staff; this is the ſtrongeſt Salt I have ſeen, and is moſt uſed for ſalting *Bacon* and *Neats-Tongues*; it makes the *Bacon* redder than other Salt, and makes the Fat eat firm; if the Swine are fed with *Maſt*, it hardens the Fat almoſt as much as if fed with *Peaſe*, and ſalted with *white* Salt. It is very much uſed by Countrywomen to put into their *Runnet Pots*, and as they ſay is better for their Cheeſe. Theſe Clods are uſed to broil Meat with, being laid on Coals. We account this Salt to be too ſtrong to ſalt Beef with, it taking away too much of its Sweetneſs.

A third ſort of Salt we have, which we call *Knockings*, which doth candy on the *Stails* of the Barrow, as the Brine runs from the Salt, after it is laded out of the *Phats*; This Salt is much uſed for the ſame Uſes as the *Clod-Salt*, tho' it is not altogether ſo ſtrong.

A fourth Sort we have, which we call *Scrapings*, that is, a coarſe Sort of Salt that is mixed with Droſs and Duſt that cleaves to the Tops of the Sides of the *Phats*; this Salt is ſcraped off the *Phats* when we reach 'em, that is, when we take our *Phats* off the Fires to beat up the Bottom, and is bought by the poor ſort of People to ſalt Meat with.

A fifth Sort is *Pigeon-Salt*, which is nothing but the Brine running out through the Crack of a *Phat*, and hardens to a Clod on the outſide over the Fire.

Laſtly, The *Salt-loaves* are the fineſt of white Salt, the Grain of which is made ſomething finer than ordinary, that it may the better adhere together; which is done by adding a little more Roſin, and is beaten into the Barrows when it is laded out of the *Phat*.

Our Salt is not ſo apt to diſſolve as *Cheſhire*-Salt, nor as that Salt that is made by diſſolving *Bay-Salt*, and clarifying it, which is called *Salt* upon *Salt*, which appears by our long keeping it without any Fire.

I believe there cannot be better white *Salt* than ours, for ſeveral Reaſons.

1. There is none can be whiter, and conſequently more free from Droſs.

2. It is the weightieſt as I have ſeen my ſelf, and been informed by others; for the Bags of Salt, I have uſually ſeen brought out of *Cheſhire* on Horſe-back, contain 6 Buſhels and a half, or 7 Buſhels; whereas the beſt Horſes that carry Salt from hence, if they carry it above 5 Miles, carry not above 3 Strike and 3 Pecks, or 4 Strike. A *Wincheſter Buſhel* of our Salt weighs half a hundred Weight; ſo that it muſt neceſſarily follow, the weightieſt and drieſt muſt needs be beſt.

3. In the time of the firſt *Dutch War* our Salt was carried down into the Weſt, where they had none before but foreign Salt; where, at firſt uſing ours, they complained that it made their Meat too ſalt; which was becauſe they put as much of ours on their Meat as of others: If ſo, it muſt be better than *French* Salt.

4. I have been aſſured by many that have made uſe both of ours and *Cheſhire-Salt*, that both for Fleſh and white Meat they muſt lay on more of *Cheſhire-Salt* than of ours.

5. It doth preſerve all Sorts of Fleſh for long Voyages, *viz.* to *Jamaica*, as well as any, which hath been lately tried.

6. I have ſeen *Herrings* that have been ſalted with our Salt in *Ireland*, and brought over to this Town, which have been whiter and better taſted than than thoſe ſalted with *Bay-ſalt.*

7. It is an ordinary Way of powdering Beef with us to give it but one ſalting to keep it the whole Year.

We uſe not *Iron Pans* as they do in *Cheſhire*, and other Places; for we have found upon Trials, that the *Strength* of the Brine doth ſo corrode, that it quickly wears out thoſe of forged Iron, and breaks thoſe of caſt Iron.

The Formation of Salt *and* Sand *from* Brine; *by Dr.* Rob. Plot. n. 145. p. 95.

XLVI. At my Requeſt two curious Obſervers, Neighbours to the Brine-Pits in *Staffordſhire*, to 8 Folds of fine *Holland* added as many more of finer *Cambrick*; through both which they ſtrained a competent Quantity of the Brine, but found nothing left in this very cloſe Colander but a little black Duſt, which they imputed only to the Foulneſs of the Water, it being nothing like Sand; for, having examin'd the Cloth both with their Fingers and a Microſcope, they could feel or ſee no more of Sand than if they had percolated the cleareſt Spring-water; and yet this Brine is found to hold in boiling at leaſt $\frac{1}{4}$ of as much Sand as Salt.

But, notwithſtanding this *Experiment*, it did not ſeem to their Apprehenſions neceſſary, that the Sand ſhould be generated in the boiling, but might rather be originally there; for, before they ſtrained it, they obſerved in the Water, by the Help of a Microſcope, a great Multitude of very minute Animals, much ſmaller than thoſe in *Pepper Water*, ſwimming about in it, together with many ſmall tranſparent Plates, ſome of them a little bigger than the Animalcules; and ſome leſs; but all of a rectangular, oblong Figure, tho' ſome indeed ſeemed very near a ſquare, which they found alſo in the Water, after ſtraining, as thick as before; the Pores, or rather Interſtices, between the Threads of the *Holland* and *Cambrick* appearing in the Microſcope 20 times greater than either the *Animalcules* or *Plates.* And theſe they judged to be the original Particles both of the Salt and Sand; which, as the Water evaporates in boiling, they thought might gather together till they made up ſuch a viſible coarſe Body, as we ſee the greater Corns of each are. Wherein they were confirmed in a little time; for obſerving with an excellent Microſcope, ſome of the ſtrong Brine, which drops from the Baskets or Barrows when the Salt is firſt put into them, though at firſt it looks like clear Water, yet upon a more accurate Obſervation it appear'd exceeding full of theſe oblong Particles; which, as they look'd on them, they could ſenſibly perceive to gather together, and club to make greater Parts; and, as the Water dried off from the Glaſs, to grow far larger and larger, till they appear'd as big, and not much unlike a large-ſiz'd Table Diamond: Which made them gueſs that the Sand might be alſo generated (if I may

I may ſay ſo) after the ſame manner, it appearing to them to be nothing (pardon the Expreſſion) but inſipid Salt, compoſed of Parts not ſo ſharp pointed as the other, but rounder and blunter angled, and conſequently not ſo pungent on the Tongue.

Upon the Suggeſtion, having ſome of the *Sand* by me, I endeavour'd to diſſolve it in fair Water, to ſee whether I could reduce it again into its former State, but without Succeſs; its Parts being ſo inſeparably fixed, that they would by no means diſſolve. I alſo tried the *Salt*, which tho' it diſſolved, yet would not render itſelf again into the Plates. Whereof ſending an Account to my Friends in *Staffordſhire*, they were pleaſed alſo to make a further Trial of diſſolving the *Sand* ſeparated from the *Salt*, and boiling; which though they confeſſed they could not do any to a conſiderable Quantity, yet they found, that after the ſtraining, it was not ſo heavy by a great deal as before, the Water that came from it being very clear; which made them believe, that it did diſſolve in ſome meaſure, unleſs, as is very probable, there were in the *Sand* ſome Particles of *Salt*, which, upon Diſſolution, were ſeparated from it, and rendred it lighter: Nevertheleſs they did not doubt, but a great Part of the Sand might alſo be diſſolved, though perhaps no great Quantity in *Pump-water*, in which it ſeems they tried it.

One of the aforeſaid Gentlemen caſually looking upon ſome of the Salt made at thoſe Pits, before it was dried and beaten ſmall, obſerved that many of the larger Corns were of the ſame Shape to the naked Eye, as the minute ones appeared in the Microſcope, and that they were viſibly made up of a great number of ſmall Plates, ſhooting up from a quadrangular oblong Baſe into a very obtuſe Pyramid, hollowed within.

XLVII. At *Northwich* in *Cheſhire*, upon the *Weever*, in 4 Pits is great Plenty of Brine; it ſtinks of *Sulphur* apparently in all the Pits; it becomes atramentous with Galls.

Obſervations on the Mid-land Salt-Spring. By Dr. Liſter. n.156.p.489

Here are uſed *Sand-pans*, which are let down in the Corners of the great Iron Boilers, before the Salt ſhoots into Grains, and theſe catch the Sand. Beſides, there are thick Stone Flakes raiſed from the Bottom of the ſaid Iron Boilers once a Week.

N. B. Within half a Mile of theſe *Brine-Pits* at *Marberry*, a Salt-Rock was found by the Augur in boring for Coals.

Vid. Inf. cap. 3.

Here, and at *Middlewich*, alſo at *Nantwich*, and all along the River *Weever*, which are Places many Miles diſtant, ſink on either Side of the River, and you will ſcarce miſs of Brine, as I was credibly inform'd by the moſt knowing Men in that particular: But yet it proves a venture, whether the Brine will be ſtrong enough to boil and turn to account; and for this Reaſon, their Pits ſometimes fail them to their great Loſs, (as they ſhewed me once which had been wrought to very great Profit) by a ſmall ſweet Spring breaking into it, and ſometimes the River *Weever* itſelf does them this Miſchief.

At *Nantwich*, upon the ſame River, is one very large Brine-pit: This Water alſo plainly ſmells as it were corrupted, or like Sulphur, but notoriouſly upon a few Days forbearance of the Pit. It becomes atramentous with Galls. It yields a white Sand or Stone, adhering in the manner of thin Scales, to the Bottom of the Iron-Pans, in which the Brine is boiled.

Weſton Brine-pit near *Stafford*. This Water in the Pit ſtinks like rotten Eggs: With Galls it becomes ſuddenly atramentous. It purges and vomits violently, and that drunk in a ſmall Quantity. Here are uſed *Sand-pans* to catch the white Sand, and there are Flakes of Stone alſo raiſed from the Bottom of the great Iron Boilers.

Mr. J. Collins, S. & Fiſh. *Droitwich* in *Worceſterſhire*: The upper *Wych* or Brine-pit is very neatly kept, and exceedingly drawn, becauſe there are ſo many Proprietors, and but a ſmall Pit, comparatively to thoſe which have been named above.

Here the Salt is boiled in ſmall Leaden Pans, and there is not the leaſt Grain of Sand at any time, which either falls before the graining of the Salt, or that adheres to the Pans bottoms, notwithſtanding what hath been ſaid to the contrary: And therefore this Brine being naturally without Sand, it muſt yield the more wholſome Salt.

The lower Pit at the *Netherwich* in the ſame Town hath but one Proprietor, as I remember, and therefore is leſs drawn, but yet is conſtantly and well wrought. Here is alſo no News or Knowledge of any Sand at all. The Water of thoſe Pits ſtink like rotten Eggs, eſpecially after *Sunday's* Reſt: And (*N. B.*) will, if Fleſh be pickled in them, make it ſtink in 12 Hours. And yet the Salt that is boiled out of theſe Pits, is accounted the very beſt Inland Salt of *England*, and I believe as good as any in the World.

I obſerved in a Ditch over-againſt the *Nether Wich-houſe*, the Water ſtanding with a white Scum, as at the *Sulphur Spaws* in *Yorkſhire*.

I ſhall add by way of Corollary.

1. That all our *Yorkſhire* Wells call'd *Sulphur Spaws* (which are many) are no other than ſo many Brine-pits, and if they were well drawn and wrought, would be as little offenſive in ſmell.

Vid. Infr. S. XLVIII. 2. That this Stone-powder is alſo to be found adhering to the Iron Pans, where the Sea-water is boiled into Salt, as it is at *Shields*, in the Biſhoprick of *Durham*; but I do not remember it to be in the Lead-pans at *Medop* and *Milthrop* in *Lancaſhire*, where the Sea-ſands are lixiviated, and that *Lixivium* of *Sea-ſalt* by *Inſolation*: Nor could I obſerve it in the leaſt, in diſtilling of Sea-water in a Glaſs Still, or in the *Yorkſhire ſtinking Wells*; of which a good Quantity is yearly made for medicinal Uſe, or rather Curioſity, to vend to Strangers.

N. B. This *Sand* falls to the Bottom before the Salt-Grains.

This is ſo alſo in all other *Mineral Salts*, whoſe Brines being boiled, ever let go firſt this ſtony Part: The *Oker* falls in Powder upon the firſt boiling, but the *Lapis Calcarius* riſes and flakes like Wafers, which yet falls in Powder by Froſt, as we have elſewhere obſerved.

3. This Stone-Powder irrigated with fair Water, and kept moiſt, does yield in immature Salt of an uncommon Figure: Which I have deſcribed at large and figured. De Font. Med. Angl.

4. Notwithſtanding the great Affinity betwixt the Salt of the Midland Brine-pits, which is common Salt, and the Sea-Salts: I muſt not omit (amongſt others) a ſpecifick Difference, which is by me (that I know off) now firſt publiſhed, and which, in my Opinion, makes the Sea-water a Water of its own kind: And alſo ſhews, that none of the Productions of incinerated Plants are truly a Marine-Salt.

The Angles of Chryſtals of common Salt, boiled out of the *Midland Brine-pits*; as alſo of Salt-Gem, or Rock-Salt, which I take to be one and the ſame, are intire; and ſo are all thoſe lixiviated marine Salt, ſo called and deſcribed by Dr. *Grew*. But the *Angles* of the *Chryſtals* of true Sea-Salt, are ever ſome of them cut off into *Triangular Planes* at one of the Sides. And this I learnt by ſuffering a Bottle of *Sea-water*, taken up upon the Coaſt at *Scarborough*, where no River near enters it, to evaporate leiſurely placed in the Shade, after it had been half boiled away; and here all the Chryſtals (which are many, and of different Magnitudes) did yet agree in a like Figure, as is deſcribed; and I do not doubt but it will ſucceed with any *Sea-water*.

*The Way of making Salt in France, by Dr. * *. n.51.p.1425*

Fig. 60.

XLVIII. *AAA*, is the *Sea*.

11, The Entry, by which the Sea-water paſſes into *BB*.

BB, The firſt Receptacle; in which the Water maketh 3 Turnings as you ſee, and is 10 Inches deep.

22, The Opening, by which the firſt and ſecond Receptacle have communication one with another.

EEF, The 3d Receptacle is properly called the *Mariſh*.

d d d d d d, Is a Channel very narrow, through which the Water muſt paſs before it enters out of the 2d Receptacle into the 3d.

33, Is the Opening, by which the Water runs out of the 2d into the 3d Receptacle.

The *Pricks* you ſee in the Water throughout the whole Scheme do mark the Courſe and Turnings which the Water is forced to make, it comes to *hhhhh*, which are the Places where the Salt is made.

h h h h h, Are the Bed of the *Mariſh*, where the Salt is made; and in them the Water muſt not be above an Inch and an half Deep. Each of theſe *Beds* is 15 Foot long, and 14 Foot large.

9 9 9 9 9, Are the little Channels between the Beds.

8 8 8 8 8, Are the Apertures, by which the Beds receive the *Sea-Water* after many Windings and Turnings.

When it rains, the *Openings*, 22, 33, are ſtopped to hinder the Water from running into the *Mariſh*. Unleſs it rain much, the Rain-water doth little hurt to the *Mariſh*; the *Heat* of the *Sun* ſufficiently exhaling it, if it be not above an *Inch* high; only if it have rained very plentifully that Day, no Salt is drawn for the 3 or 4 next Days. But if it Rain 5 or 6 Days, the People are then neceſſitated to empty all the Water of the Beds by a peculiar Channel, which cannot be opened but when it is low Water. But 'tis very ſeldom that it Rains ſo long as to conſtrain Men to empty thoſe Beds.

The hotteſt Years makes the moſt Salt, and the hotteſt part of the *Summer* there is Salt made even during Night. Leſs *Salt* in calm, than in windy Weather.

The Weſt and North-weſt Winds are the beſt for this Purpoſe.

Our Country People draw the Salt every other Day, and every Time more than an hundred Pound Weight of Salt.

The Inſtruments uſed to draw the Salt, have many ſmall Holes to let the Water paſs, and to retain nothing but the Salt.

The reddiſh Earth in *Mariſhes* make the Salt more grey; the blewiſh, more white: Beſides, if you let run in a little more Water than you ought, the Salt becomes then more white, but then it yields not ſo much. Generally all the *Mariſhes* require a fat Earth, neither ſpungy nor ſandy.

The Salt-man who draws the Salt, muſt be very dextrous. In this *Iſle* of *Rhee*, Men there are, that draw very dark Salt, and others that draw it as white as Snow; and ſo it is in *Xaintonge*. Chiefly, care is to be taken that the *Earth* at the Bottom of the Beds mingle not with the Salt.

The Salt we uſe at our Tables is perfectly white, being the *Cream* (or that Salt which is formed on the Top of the Water) drawn 4 or 5 Hours before the Salt is to be drawn. The Grains of it are ſmaller than of the other. Generally the Salt of *Xaintonge* is ſomewhat whiter than ours. The Bigneſs of our Salt is of the Size of a Pepper-Grain, and of a cubical Shape.

The *Mariſhes* are preferred from one Year to another, by overflowing them a Foot high.

The Timber of the *Mariſhes*, if it be of good *Oak*, keeps near 30 Years, but there is uſed but little *Wood*, all the *Ditches* and *Apertures* being done with *Stones*.

In Lancaſhire, *by Dr.* J. Beal, n. 103. p. 51.

XLIX. At *Wire-water* in *Lancaſhire*, *Salt* is gathered out of Heaps of *Sand* along the Sea-ſide in many Places: Upon which Sand (ſaith *Speed*) the People pour Water, until it gets a ſaltiſh Humour, which they afterwards boil with Turfs, till it becomes white Salt.

The Water of the Brine-pits in Summer-time, when the Brine is ſtrongeſt, being caſt into any Place where it may be ſoon dried by the *Sun*, and where we would have *Pidgeons* reſort, does pleaſe them well; ſo will any refuſe Brine being boiled up to a Conſiſtence. But I know not whether ſuch Brine, taken from the powder'd Fleſh, will be kind for Sheep.

In Germany, *by* * * *. 7. p. 128.

L. An obſerving Gentleman writes out of *Germany*, That no *Salt-water* which contains any *Metal* with it, can well be ſodden to ſalt in a Veſſel of the ſame *Metal* which itſelf contains, except *Vitriol* in *Copper Veſſels*.

He adds, that to ſeparate Salt from Salt-water without Fire, if you take a Veſſel of *Wax*, hollow within and every where tight, and plunge it into the *Sea*, or into other *Salt-water*, there will be made ſuch a Separation, that the Veſſel ſhall be full of ſweet Water, that Salt ſtaying behind; but though this Water have no ſaltiſh Taſte, yet he ſaith, there will be found a *Salt* in the Eſſay which is the *Spirit* of *Salt*, ſubtile enough with the Water to penetrate the Wax.

LI. We have ſeen here (at *Leyden*) a Maid, of 13 Years of Age, which from the Time that ſhe was but 6 Years old, and began to be about her Mother in the Kitchen, would, as often as ſhe was bid to bring her Salt, or could elſe come at it, fill her Pockets therewith, and *eat* it, as other Children do Sugar; whence ſhe was ſo dried up, and grown ſo ſtiff, that ſhe could not ſtir her Limbs, and was thereby ſtarved to Death.

The Joints of a Girl made Stiff by eating Salt. *By* . . . . . n. 8. p. 138.

LII. *Papers of leſs general Uſe*, omitted.

1. SOME Objections of the *Fr. Journaliſt* to the *Engines* for *drawing up Water from the Bottom of the Sea*, and for *ſounding the greateſt Depths*. n.13. p.228.
2. Inquiries concerning the *Sea*; by Mr. *Robert Boyle*. n.18. p.315.
3. Inquiries and Directions concerning *Tides*; propoſed by Dr. *J. Wallis*. n.17. p.297.
4. Patterns of *Tables* propoſed to be made for obſerving of *Tides*; by Sir *Robert Moray*. n.18. p 311.
5. Quæries about *Tides* in *China* and the *Eaſt-Indies*; by Mr. *Edm. Halley*. n.162.p.685
6. Several Engagements for *obſerving* of *Tides*. n.21. p.679.
7. A Correct *Tide-Table*, ſhowing the true Time of *High-Water* at *London-Bridge* to every Day in the *Year* 1682; by Mr. *Flamſtead*. *Phil. Col.*: n. 4. p. 102.
8. The ſame, for the *Year* 1683. n.143. p.10.
9. The ſame, for the *Year* 1684. n.153.p.458
10. The ſame, for the *Year* 1685. n.166.p.821
11. The ſame, for the *Year* 1686. n. 177. p. 1226.
12. The ſame, for the *Year* 1687. n.185.p.132
13. The ſame, for the *Year* 1688. n.191.p.428
14. Objections from *Voſſius*, *De Motu Marium & Ventorum*, and from *Gaſſendus*, *De Æſtu Maris*, to Dr. *Wallis's Theory* of *Tides*, anſwer'd; by Dr. *Wallis*. n.16. p.286.
15. Quæries and Conjectures concerning *Mineral Waters*; by Dr. *Dan. Foot*. n.52. p.1504
16. An Inquiry concerning the *Cauſes* of *Mineral Springs*; propoſed by Dr. *J. Beal*. n.56.p.1131.
17. Some Quæries whereby to examine *Mineral Waters*; by Sir *W. Petty*. n.166.p.802
18. Inquiries about the *Salt-Springs* in *Worceſterſhire* and *Cheſhire*; by Dr. *J. Beal*. n.20. p.359.
19. Inquiries and Suggeſtions concerning Salt for *Domeſtick Uſes*; by Dr. *J. Beal*. n.103. p.48.

LIII. *Accounts, Reſolutions and Foundations of Books*, omitted.

1. IS *Voſſius de Motu Marium & Ventorum*. n.16. p.286.
2. *Gaſſendus de Æſtu Maris*. ib. p.287.

3. De

n.167.p.862. 3. De Origine *Fontium* Tentamen Philoſophicum, in Prælectione habita coram *Societate Philoſophica* nuper *Oxoniæ* inſtituta ad *Scientiam Naturalem* promovendam. Per *Rob. Plot*, L. L. D. *Oxon* 1685. in 8vo.

n.233.p.734 4. De *Fontium Mutinenſium* admiranda Scaturigine, Tractatus Phyſico-Hydroſtaticus *Bernardini Rammazini*, in Mutinenſi Lycæo Med. Prof. Mutinæ 1691. in 4to. Tranſlated into *Engliſh* and illuſtrated with many curious Remarks and Experiments by the Author, and Tranſlator, Dr. *Rob.* St. *Clair*, *Lond.* 1697. in 8vo.

n.51.p.1038 5. Dr. *Tobias Whitaker* of drinking *Mineral Waters*, 1634.

n.42. p 850. 6. *Hydrologia Chimica*, or the Chymical Anatomy of the *Scarborough* and other *Spaws* in *Yorkſhire*, *&c.* by *W. Sympſon*, *Lond.* 1668. in 8vo.

n.49.p.999. 7. An Anſwer to *Hydrologia Chymica* of *Will. Sympſon*, by *Rob. Wittie*, M.D.
n.51.p.1038 *Lond.* 1669. in 8vo. *Beſides the* Account *of this* Book, *there is a Correction of a Miſtake of the Printer in the* 3d Page.

n.52.p.1050 *Some Reflections made on this Account of* Dr. Wittie's *Anſwer to* Hydrologia Chymica; *by* Dr. Dan. Foot.

n.57.p.1154 Dr. Foot's *Reflections conſider'd*; *by* Dr. J. Beal.

n.56.p.1128 *Some Conſiderations relating to* Dr. Wittie's *Defence of the* Scarborough Spaw, *by* Dr. Highmore.

n.60.p.1674 *A Diſcourſe of* Dr. Rob. Wittie, *relating to the Notes and Queries of* Dr. Foot, *and to thoſe of* Dr. Highmore, *concerning* Mineral Waters, *and* Extracts made out of them.

n.62.p.2032 8. A Vindication of *Hydrologia Chymica*, by *Will. Sympſon*, M. D. *Lond.* 1670.

n.85.p.5019 9. *Scarborough Spaw* ſpagyrically anatomiz'd. *An.* 1670. and a *New Year's Gift* for Dr. *Wittie*, *Lond.* 1671. both in 12mo. by *Geo. Tonſtal*, M. D.

n.144.p.59. 10. 1. M. *Liſter*, M. D. *De Fontibus Medicatis Angliæ*; Exercitatio Nova & Prior. *Eboraci* 1682. in 8vo.

n.518.p.579 2. M. *Liſter*, M. D. *De Fontibus Medicatis Angliæ*; Exercitatio altera. *Lond.* 1684. in 8vo.

n.172.p.1063 11. Short *Memoirs* for the *Natural Experimental Hiſtory* of *Mineral Waters*, by the Honourable *Rob. Boyle*, *Lond.* 1685. in 8vo.

n.206.p.1603 12. Tentamen Philoſophicum de *Aquis Mineralibus*, &c. Auth. *Carolo Leigh*, M. D. *Lond.* 1694. in 8vo. *Dr.* Cay *here objects many Things to that* Author's *Obſervations.*

n.248.p.368 13. The *Natural Hiſtory* of the *Chalybeat* and *Purging Waters of England*, with
n.251.p.146 their particular Eſſays and Uſes, *&c.* with Obſervations on the Bath-waters in *Somerſetſhire*, by *Benj. Allen*, M. D. *Lond.* 1699.

n.225.p.612 14. Obſervations ſur les *Eaux Minerales* des pluſieurs Provinces de *France* faites en *l' Acadamie Royale* des *Sciences*, *en l' Anne* 1670 & 1671. par le Sieur de Clos. A *Paris* 1675. in 12mo.

n.125.p.573 15. *Bathonienſium* & Aquiſgranenſium Thermarum Comparatio, variis adjunctis illuſtrata, a *R. P.* Lond. 1676. in 8vo.

CHAP.

CHAP. III.

Mineralogy.

I. 1. THE *Mine* or *Adit* is to be made 7 or 8 Foot high, which tho' it ſeems to make more Work downwards, yet will be found neceſſary for making the better Diſpatch by rendring the *Invention* more effectual.

There is a Tool of Iron well ſteeled at the End, which cuts the Rock (of the Shape ſhewed by the *Figure* annexed) 20 or 22 Inches long or more, and ſome 2 ½ Inches Diameter at the ſteeled End, the reſt being ſomewhat more ſlender. The ſteeled End is ſo ſhaped, as makes it moſt apt to pierce the Rock, the Angles at the End being ſtill to be made the more obtuſe, the harder the Rock is. This Tool is to be firſt held by the Hand in the Middle between the Sides of the Rock that is to be cut, but as near the Bottom as may be. The Tool being placed, is to be ſtruck upon with a Hammer, the heavier the better, either ſuſpended by a Shaft turning upon a Pin, or otherwiſe, ſo ſoon as one Man may manage the Hammer, while another holds the Tool or *Piercer*. If it be hung in a Frame or other convenient way, he that manageth it, hath no more to do but to pull it up at firſt as high as he can, and let it fall again by its own Weight, the Motion being ſo directed as to be ſure to hit the Piercer right. After the Stroke of the Hammer, he that holds the Piercer, is to turn it a little on its Point, ſo that the Edges or Angles at the Point may all ſtrike upon a new Place, and ſo it muſt ſtill be ſhifted after every Stroke, by which means ſmall Chips will at every Stroke be broken off, which muſt from time to time be taken out, as need requires. And thus the Work muſt be continued, till the Hole be 18 or 20 Inches deep, the deeper the better. This Hole being made deep as is required, and kept as ſtraight and ſmooth in the Sides as is poſſible, there is then a kind of double Wedge to be made, and fitted exactly for it, the Shape whereof is to be ſeen in the annexed Figure.

To break hard Rocks, by M. Duſons, n. 5. p. 82.

Fig. 67.

This double Wedge being 12 or 13 Inches long, each piece of it, and ſo made as being placed in their due Poſition, they may make up a *Cylinder*, cut *Diagonal wiſe*. The two Flat-ſides, that are contiguous, are to be greaſed or oiled, that the one may ſlip the more eaſily upon the other; and one of them, which is to be uppermoſt, having at the great End a hollow Creaſe cut into it round about, for faſtning a Cartridge full of *Gun-powder* to it with a Thread, the round End of the Wedge being pared as much as the Thickneſs of the Paper or Paſt-board that holds the *Powder* needs, to make the Outſide thereof even with the reſt of the Wedge. This Wedge muſt have a Hole drilled through the longeſt Side of it, to be filled with *priming Powder*, for firing of the *Powder* in the *Cartridge:* Which needs have no more than half a Pound of Powder, though upon occaſion a greater Quantity may be uſed, as ſhall be found requiſite.

Fig. 68.

Then this Wedge being firſt thruſt into the Hole with the Cartridge, the round Side, where the priming Hole is, being uppermoſt, the other Wedge is to be thruſted in, home to the due Poſition, care being taken that they fit the Hole in the Rock as exactly as may be. Then the End of the lower Wedge being about an Inch longer than that of the upper, outwardly and flatten'd, *priming Powder* is to be laid upon it, and a Piece of burning *Match* or Thread dipt in Brimſtone, or other ſuch prepared combuſtible Matter, faſtned to it, that may burn ſo long before it fire the *Powder*, as he that orders it may have time enough to retire quite out of the *Pit* or *Adit*, having firſt placed a piece of Wood or Iron ſo as one End thereof being ſet againſt the End of the lower Wedge, and the other againſt the Side-Wall, ſo as it cannot ſlip. Which being done, and the Man retired, when the *Powder* comes to take Fire, it will firſt drive out the uppermoſt Wedge as far as it will go; but the ſlaunting Figure of it being ſo made, as the farther it goes backward the thicker it grows, till at laſt it can't go no farther, then the Fire tears the Rock to get forth, and cracks and breaks it all about, that at one Time a vaſt deal of it will either be quite blown out, or ſo crack'd and broken as will make it eaſy to be removed.

By Mr Beaumont, n. 167. p. 845. *Fig.* 69.

2. A conſiderable *Adventurer* in the *Lead-Mines* on *Mendip-Hills* acquaints me, that the *Miners* there, within theſe 12 Months, had got a new way of *Cleaving Rocks* with *Gun-Powder*.

The *Borer* is made of Iron, and is 2 Foot 2 Inches in Length: It is an Inch Square at the ſteeled End from *a* to *b*, and ſomewhat leſs in the other Part. The Uſe of this Inſtrument is to make a Hole in the Rock deep enough to receive the *Powder*. The Gun is 6 Inches in length, 1 ¼ Diameter, and has a Hole drilled through it to receive the *priming Powder*. When a Hole is made with the *Borer* ſomewhat deeper than the length of the *Gun*, they dry it with a Rag, and put into it about 2 or 3 Ounces of *Powder*, over which they put a thin Paper, and on it place the Gun, which they bind firmly into the Hole, by driving in againſt the flat Side of the upper Part of it a little Iron Wedge 4 Inches in length, by the *Miners* called a *Quinnet*.

Fig. 71.

When this is done, they paſs down a Wire through the Hole drilled in the Gun, and pierce the Paper which covers the *Powder*, and then they *prime* the *Gun*, and lay a *Train*, and go up out of the Work, before the *Powder* comes to take Fire. The *Paper* is put at firſt over the *Powder*, leſt when the *Gun* and *Quinnet* are driven down, the Tools may ſtrike Fire, and kindle the *Powder*.

Theſe Inſtruments are of great Advantage to *Miners*; for as ſoon as a Man has fired his *Powder*, and broken the Rock, he may preſently go to Work again; whereas after a Fire is laid in a Shaft, a Man can ſcarce go to Work in 24 Hours, the Rocks being too hot to ſuffer him.

Okey Hole, *and ſome other* Subterraneous Caverns *in* Mendip-Hills; *by Mr* J. Beaumont, *Phil. Col.* n. 2. p. 1.

II. 1. On the South-Side of *Mendip-Hills*, within a Mile of *Wells*, is a famous *Grotto*, known by the Name of *Okey-hole*, much reſorted to by Travellers: The Entrance of it is in the Fall of thoſe Hills, which is there all beſet with Rocks, having near it a precipitous Deſcent about 10 or 12 Fathom deep; at the Bottom of which there always iſſues from the Rock a conſiderable Current of Waters. The naked Rock above the Entrance, ſhew themſelves for about 30 Fathom in Height; though the whole Aſcent of the Hill above it is about a Mile, and is very ſteep.

As you paſs into this *Vault* you go upon a Level; but, advancing further into it, you find the Way rocky and uneven, ſometimes aſcending, and ſometimes deſcending, as generally in all Caverns. The Roof of it, in the higheſt Part, is about 8 Fathoms from the Floor; and in ſome Places it is ſo low, that a Man muſt ſtoop to paſs. The Wideneſs of it is alſo various; in ſome Parts it is about 5 or 6 Fathoms; in others, not above a Fathom or two: It extends itſelf in Length about 200 Yards. People talk much of ſeveral Stones there, reſembling Men, and other Things; but they are only Lumps of common *Sparr*, without any *regular Figures*.

At the fartheſt Part of this *Cavern* there riſes a good Stream of *Water*, large enough to drive a Mill, which paſſes all along one Side of the *Cavern*, and at length glides down about 6 or 8 Fathoms betwixt the Rocks; and then, preſſing through the Clefts of them, diſcharges itſelf into a Valley.

This *River* within the *Cavern* is well ſtored with *Eels*, and hath ſome *Trouts* in it, which muſt of Neceſſity have been *engendred* there, and not come from without, there being ſo great a Fall, as I have mentioned, near the Entrance. It happen'd ſome few Years ſince, that many Cattle, which fed in Paſtures through which this River paſſes, died ſuddenly after a Flood; the Cauſe of it being ſuppoſed to be, that theſe Waters had a Communication under Ground in *Mendip-Hills* with certain Waters which came from the Waſhing of *Lead-Ore* in the *Minery-Ponds*, which are two Miles and a Half diſtant from this *Cavern*, and were convey'd into the Ground by a *Swallow*, near the Place where the *Ore* was waſh'd; which *Swallow* has ſince been cauſed to be damm'd up.

In a dry Summer I have ſeen a good Number of *Frogs* all along this *Cavern*, even to the fartheſt Part of it, and other little *Animals* in ſome ſmall *Ciſterns* of *Water* there.

Before you come to the Middle of this *Vault*, you will find a Bed of very fine Sand, which is much ſent for by Artiſts to caſt *Metals* in.

On the Roof of it, at certain Places, hang Multitudes of *Batts*: And indeed we generally find them in all *Caverns*, whoſe Entrance is upon a Level, or ſomewhat aſcending or deſcending, ſo it be not perpendicularly; and even in theſe, if the Paſſage into them be not narrow, and of a conſiderable Height or Depth.

2. About 5 Miles from this, on the South-weſt Part of *Mendip-Hills*, near a Place called *Chedder*, lies another *Cavern*, into which you muſt aſcend about 15 Fathoms on the Rocks. This *Cavern* is not of ſo large an Extent as the former; there is no Current of Water, nor does Water drop ſo freely from the Roof, as generally in other *Caverns*; wherefore the *Sparrs* appear not of ſo lively Colours, as commonly elſewhere.

3. Theſe two *Caverns* have no Communication with *Mines*: But we generally obſerve, that, whereſoever *Mines* of *Lead-Ore* are, there are *Caverns* belonging to them, which are of a various Nature and Situation. The moſt conſiderable of theſe *Vaults*, I have known on *Mendip-Hills*, is on the moſt Northerly Part of them, in a Hill call'd *Lamb*, lying above the Pariſh of *Harptry*. Much *Ore* has been formerly raiſed on this Hill; and being told,

ſome Years ſince, that a very great *Vault* was there diſcover'd, I took 6 *Miners* with me, and went to ſee it. Firſt we deſcended a perpendicular *Shaft* about 10 Fathoms; then we came into a *Leading Vault*, which extends itſelf in Length about 40 Fathoms; it runs not upon a Level, but deſcending, ſo that when you come to the End of it, you are 23 Fathoms deep, by a perpendicular Line. The Floor of it is full of looſe Rocks; its Roof is firmly *vaulted* with Lime-Stone Rocks, having Flowers of all Colours hanging from them, which preſent a moſt beautiful Object to the Eye, being always kept moiſt by the diſtilling Waters. In ſome Parts the Roof is about 5 Fathoms in Height, in others ſo low, that a Man has much ado to paſs by creeping. The Wideneſs of it, for the moſt Part, is about 3 Fathoms. This *Cavern* croſſes many *Veins* of *Ore* in its running, and much *Ore* has been thence raiſed. About the Middle of this *Cavern*, on the Eaſt Side, lies a narrow Paſſage into another *Cavern*, which runs betwixt 40 and 50 Fathoms in Length. *Vid. Inf.* 5. At the End of the *firſt Cavern* a *vaſt Cavern* opens itſelf. I faſtened a Cord about me, and ordered the *Miners* to let me down: And upon the Deſcent of 12 or 14 Fathoms I came to the Bottom. This *Cavern* is about 60 Fathoms in *Circumference*, above 20 Fathoms in Height, and about 15 in Length; it runs along after the *Rakes*, and not *croſſing* them as the leading *Vault* does. I afterwards cauſed *Miners* to drive forward in the Breaſt of this *Cavern*, which terminates it to the Weſt; and, after they had driven about 10 Fathoms, they happened into another *Cavern*, whoſe Roof is about 8 Fathoms, and in ſome Parts 10 or 12 in Height, and runs in Length about 100 Fathoms.

The Frequency of theſe Caverns on thoſe Hills may be eaſily gueſs'd at, by the Frequency of *Swallow-Pits* which occur there in all Parts, and are made by the falling in of the Roofs of Caverns; ſome of theſe Pits being of a large Extent and very deep; and ſometimes our *Miners*, ſinking in the Bottom of thoſe Swallows, have found *Oaks* 15 Fathoms deep in the Earth.

Elden-Hole *in* Derbyſhire, by *Dr.* Plot, ib. p.7. Ph.Col. n. 2. p. 7.

III. Dr. *Plot* has learnt by an inquiſitive Gentleman, who purpoſely made Trial of it, that one of thoſe Caverns in the *Peak* in *Derbyſhire* hath been ſounded in Depth, by a perpendicular Plumb-Line, no leſs than *Eight and Twenty Hundred* Feet, without meeting with the Bottom, or Water; and yet the Mouth of this Cavern, at the Top, is not above 40 Yards over.

Pen-Park-Hole *in* Glouceſterſhire, *by Capt.* Sturmy, n. 143. p. 2.

IV. 1. Upon the 2d of *July*, 1699, I deſcended by Ropes affix'd at the Top of an old *Lead Ore Pit*, 4 Fathoms almoſt perpendicular; and from thence 3 Fathoms more obliquely, between two great Rocks, where I found the Mouth of this ſpacious Place; from which a *Mine-Man* and myſelf lower'd ourſelves by Ropes 25 Fathoms perpendicular, into a very large Place, which reſembled to us the Form of a Horſe-Shoe; for we ſtuck lighted Candles all the Way we went to diſcover what we could find remarkable. At length we came to a River or great Water, which I found to be 20 Fathoms broad, and 8 Fathoms deep. The *Mine-Man* would have perſuaded me, that this River ebbed and flowed; for that ſome 10 Fathoms above the Place we now were in we found the Water had ſometimes been: But I proved the contrary,

trary, by ſtaying there from 3 Hours *Flood* to 2 Hours *Ebb*, in which Time we found no Alteration of this River. Beſides, its Waters are freſh, ſweet, and cool; and the Surface of this Water, as it is now at 8 Fathoms deep, lies lower than the Bottom of any Part of the *Severn Sea* near us, ſo that it can have no Community with it. As we were walking by this River, 32 Fathoms under the Ground, we diſcovered a great Hollowneſs in a Rock ſome 3 Foot above us; ſo that I got a Ladder down to us, and the *Mine-Man* went up the Ladder to that Place, and walk'd into it about 70 Paces, till he juſt loſt a Sight of me, and from thence chearfully called unto me, and told me he had found what he look'd for, a *Rich Mine*. But his Joy was preſently turned into Amazement, and he returned affrighted by the Sight of an *Evil Spirit*, which we cannot perſuade him but he ſaw, and for that Reaſon will go thither no more.

Here are Abundance of ſtrange Places; the Flooring being a Kind of white Stone enamell'd with *Lead-Ore*, and the pendant Rocks were glazed with *Salt-Petre*, which diſtilled upon them from above, and Time had petrify'd.

By Sir Rob. **Southwell,** *ibid.*

Four Days together after his Return Capt. *Sturmy* was troubled with an unuſual and violent Head-ach, which he imputed to his being in that Vault; and, falling from his Head-ach into a Fever, he ſoon after died.

By Captain Collins, ib. p. 4.

Fig. 1, 72, 73.

2. 'Tis down the *Tunnel CC*, from the *Superficies* of the *Earth AA*, to the Opening of the *Cavity* below, 39 Yards. Then the *Hole EE*, ſpreading into an irregular oblong Figure, is in the greateſt Length 75 Yards, and in the greateſt Breadth 41 Yards. From the higheſt Part of the Roof to the Water was then 19 Yards. The Water *HH* was now in a Pool at the North End, being the deepeſt Part; it was in Length 27 Yards, in Breadth 12, and only five Yards and an Half deep. Two Rocks *GG* and *LL* appeared above the Water all covered with *Mud*: But the Water was ſweet and good. There was a large Circle of *Mud KKK*, round the Pool, and far up towards the South End, which ſhew'd that the Water has at other Times been 6 Yards higher than at this preſent.

Sept. 18 and 19, 1682. The *Tunnel* or Paſſage down was ſomewhat oblique, very ragged and rocky; in ſome Places it was two Yards wide, and in ſome three or four; but nothing obſervable therein, ſave here and there ſome of that *Sparr* which uſually attends the *Mines* of *Lead-Ore*. In the Way, 30 Yards down, there runs in Southward a Paſſage *DD*, of 29 Yards in Length, parallel to the *Superficies* above; it was two or three Yards high, and commonly as broad and alike rocky as the *Tunnel*, with ſome Appearances of *Sparr*, but nothing elſe in it except a few *Batts*.

The *Cavity* below was in like Manner rocky and very irregular; the Candles and Torches burnt clear, ſo as to diſcover the whole Extent thereof; nor was the Air any thing offenſive.

The Bottom of this Hole *I*, where the *Land-Waters* do gather, is 59 Yards down from the *Superficies* of the Earth; and by good *Calculation* the ſame Bottom is twenty Yards above the higheſt Riſing of the *Severn*, and lies into the Land about three Miles diſtant from it, and about as far from *Briſtol*.

V. One

Air in Mines; by Mr. J. Gill. n.26. p.481.

V. One *John Gill* affirms, from 20 Years Experience of his own, that if in digging deep under Ground the Workmen meet with Water, they never want *Air* or *Wind*; but if they miſs Water (as ſometimes it happens, even at 12 or 16 Fathoms deep) they are deſtitute of convenient Air, either to breathe in, or to make their Candles burn; and that when they drive up an *Adit* for drawing away a great Quantity of a Winter's ſtanding Water from a deep Mine, as ſoon as it is brought up ſo near that any of the ſtanding Water begins to run away, the Men muſt ſecure themſelves as well as they can from Danger of being daſhed in Pieces againſt the Sides of the *Adit*; for the included Air or Wind, in the ſtanding Water, breaks forth with ſuch a terrible Noiſe as that of a Piece of *Ordnance*, and with that Violence, as to carry all before it, looſening the very Rocks, though at ſome Diſtance, in the Work or *Adit*.

To Work in Mines *without* Airſhafts; *by Sir* Rob. Moray, n. 5. p. 97.

VI. At the Mouth or Entry of the *Adit* (to the *Coal-Mines* of *Leige*) there is a Structure raiſed of Brick like a Chimney, ſome 28 or 30 Foot high in all; at the Bottom two oppoſite Sides are, or may be, ſome 5½ Foot broad, and the other two 5 Foot; the Wall 1½ Brick thick. At the lower Part of it is a Hole ſome 9 or 10 Inches ſquare, for taking out of the *Aſhes*, which when it is done, this *Aſh-Hole* is immediately ſtopt ſo cloſe, as Air cannot poſſibly get in at any Part of it. Then ſome 3 Foot above Ground, or more, there is on that Side that is next to the *Adit*, or Pit, a ſquare Hole, of 8 or 9 Inches every Way, by which the Air enters to make the Fire burn: Into this Hole there is fix'd a ſquare *Tube* or *Pipe* of Wood, whereof the Joints and Chinks are ſo ſtopped with Parchment paſted or glewed upon them, that the Air can no where get into the *Pipe* but at the End; and this *Pipe* is ſtill lengthened as the *Adit* or Pit advanced, by fitting new *Pipes* ſo as one End is always thruſt into the other, and the Joints or Chinks ſtill carefully cemented, and ſtopt as before. So the *Pipe* or *Tube* being ſtill carried on, as near as is neceſſary to the Wall or Place where freſh Air is requiſite, while the Air is drawn by the Fire from thence through the *Tube*, freſh Air muſt needs come in from without, to ſupply the Place of the other; which by its Motion doth carry away with it all the ill Vapours that breathe out of the Ground: By which Means the whole *Adit* will be always fill'd with freſh Air, ſo that Men will there breathe as ſurely as abroad, and not only Candles burn, but Fire, when upon Occaſion there is Uſe for it for breaking of the Rock.

There muſt be two of the Iron Grates, that when any Accident befalls the one, the other may be ready to be put into its Place; the *Coal* being firſt well kindled in it: But when the Fire is near ſpent, the Grate, being haled up to the Door, is to be ſupplied with freſh Fewel.

The higher the Shaft of the Chimney is, the Fire draws the Air the better. And this Invention may be made uſe of in the Pits or Shafts that are perpendicular, or any ways inclining towards it, when there is Want of freſh Air at the Bottom thereof, or any Moleſtation by unwholeſome Fumes or Vapours.

The whole Contrivance of the Fabrick may eaſily be underſtood by the annexed Figure. *Fig.* 74.

A The *Hole* for taking out the *Aſhes*; *B* the ſquare Hole, into which the *Tube* or *Pipe* for conveying the *Air* is to be fitted; *C* the Border or Ledge of *Brick* or *Iron*, upon which the *Iron Grate* or *Cradle*, that holds the burning Coals, is to reſt; the one being exactly fitted for the other: *D* the *Hole* where the Cradle is ſet; *E* the wooden *Tube*, thro' which the *Air* is convey'd towards the *Cradle*; *F* the Door, by which the Grate or *Cradle* is let in which is to be ſet 8 or 10 Foot higher than the Hole *D*; and the Shutter made of Iron, or Wood that will not ſhrink, that it may ſhut very cloſe; *G* the *Grate* or *Cradle*, which is narrower below than above, that the *Aſhes* may the more eaſily fall, and the *Air* excite the Fire, the Bottom and Sides being barred; *H* the *Border* or *Ledge* of the *Cradle*, that reſts upon Ledge *C*; *I* four *Chains* of *Iron* faſtened to the four Corners of the *Cradle*, for taking it up and letting it down; *K* the *Chain* or *Iron* to which the other *Chains* are faſten'd; *L* the Pully of Iron or Braſs through which the *Chain* paſſeth; *M* a *Hook* on which the *Chain* is faſten'd by a Ring, the *Hook* being fixed at the Side of the *Door*; *N* a Bar of Iron in the Walls, to which the Pully is faſten'd.

VII. 1. In a *Coal-Pit*, belonging to the Lord *Sinclair* in *Scotland*, where the *Coal* is ſome 18 or 20 Foot thick, and antiently waſted to a great Depth, the *Colliers*, ſome Weeks ago, having wrought as deep as they could, and being to remove into new Rooms, as they call them, did, by taking off, as they retired, Part of the *Coal* that was left as Pillars to ſupport the *Roof* and *Earth* over it, ſo much weaken them, that, within a ſhort Space after they were gone out of the *Pit*, the *Pillars* falling, the Earth above them filled up the whole Space, where the *Colliers* had lately wrought, with its Ruins. The *Colliers* being hereby out of Work, ſome of them adventur'd to work upon old Remains of Walls ſo near the old Waſtes, that, ſtriking thro' the ſlender Partition of the *Coal-Wall* that ſeparated between them and the Place where they uſed to work, they quickly perceived their Error; and fearing to be ſtifled by the bad Air that they knew poſſeſſed theſe old Waſtes, in Regard not only of the *Damps* which ſuch Waſtes do uſually afford, but becauſe there had been, for many Years, a *Fire* in thoſe *Waſtes* that filled them with ſtifling Fumes and Vapours, retired immediately, and ſaved themſelves from the *Eruptions* of the *Damp*. But next Day ſome 7 or 8 of them came no ſooner ſo far down the Stairs, that led them to the Place where they had been the Day before, as they intended, but, upon their ſtepping into the Place where the Air was infected, they fell down dead, as if they had been ſhot: And there being amongſt them one whoſe Wife being informed he was ſtifled in that Place, ſhe went down ſo far without Inconvenience, that, ſeeing her Huſband near her, ſhe ventur'd to go to him; but, being choaked by the Damp as ſoon as ſhe came near him, ſhe fell down dead by him. Damps in Mines, *by Sir* R. Moray, n. 3. p. 4.

2. *Damps* happen in moſt of the *Hungarian Mines*, not only in the *Cuniculi*, or *direct Paſſages*, where they walk on *Horizontally* (by theſe *Mine-Men* called *Stollen*) *By Dr.* Edw. Brown, n. 48. p. 965.

Stollen;) but alſo in the *Putei*, or perpendicular Cuts or Deſcents, termed *Schachts* by the ſame. They are met with not only in Places where the Earth is full of *Clay*, or the like Subſtances, but alſo where it is rocky: And one Place they ſhewed me, in the Copper-Mine at *Hern-Groundt*, where there had been a very pernicious Damp, and yet the Rock ſo hard, that it could not be broken by their Inſtruments; but the Deſcent was all made by the Means of Gun-Powder, rammed into long round Holes in the Rock, and ſo blown up. Another Place they ſhewed me, where there is ſometimes a Damp, and ſometimes clear Weather. When there is much Water in the *Mine*, ſo as to ſtop up the lower Part of this Paſſage, then this Damp becomes diſcoverable, and commonly ſtrong. I procured one to enter it till his Lamp went out 4 or 5 Times, in the ſame Manner as at *Grotto del Cane* in *Italy*.

Some of theſe Damps ſuffocate in a ſhort Space of Time; others only render the Workmen faint, with no further Hurt, except they continue long in the Place. The *Miners* here think themſelves no Workmen if they be not able to cure a Damp, or to cure the bad Weather, or make the Weather, as they term it, perform it by Perflation, by letting the Air in and out; and cauſing, as 'twere, a Circulation of it. In the Mine at *Hern-Groundt* they cured a bad Damp by a great Pair of Bellows, which were blown continually for many Days. The ordinary Remedy is by long Tubes; thro' which the Air continually paſſing, they are able to dig ſtraight on for a long Way, without Impediment in breathing: For ſome *Cuniculi* are 500 Fathoms long, which will not ſeem ſtrange to any one that ſhall ſee the Map of the *Copper-Mine* at *Hern-Groundt*, or the *Gold-Mine* at *Schemnitz*: And in the *Silver Trinity-Mine* by *Schemnitz* I paſſed quite under a Hill, and came out on the other Side. At *Windſchach-Mine* by *Schemnitz* they ſhewed me the Place where 5 Men and a Gentleman of Quality were loſt; for which Reaſon they have now placed a Tube there. The like they place over all *Doors*, and over all *Ways*, where they dig right on for a great Space, and have no Paſſage thro'. At *Schemnitz* they told me, that 28 Men had been killed at one Time in 4 *Cuniculi*, 7 in each; and in the Sinking of *Leopold*'s Pit, which is 150 Fathoms deep, they were much troubled with Damps, which they remedied in the following Manner:

They fixed a Tube to the Side of the *Schacht*, or Pit, from the Top to the Bottom; and, that not proving ſufficient, they forced down a broad, flat Board, which covered or ſtopped the Pit, or couched very near the Sides of it, on all Sides but where the Tube was, and ſo forced out all the Air in the Pit through the Tube; which Work they were forced often to repeat. And now, they having divers other Paſſages into it, the Air is good and ſufficient, and I was drawn up thro' it without the leaſt Trouble in Breathing.

But, beſides this Miſchief from poiſonous Exhalations, Stagnation of the Air, or Water impregnated with mineral Spirits, they ſometimes periſh by other Ways: For there being in theſe Mines an incredible Quantity of Wood to ſupport the Pits, and the Horizontal Paſſages (the *Putei* and *Cuniculi*) in all Places but where it is rocky, Men are ſometimes deſtroyed by the Wood ſet on Fire. And in the Gold-Mine at *Schemnitz* the Wood was ſet once on Fire by the Careleſneſs of a Boy, and 50 Miners ſmothered thereby; who were all taken out but one, that was afterwards found to be diſſolved by the *Vitriol-Water*, nothing eſcaping either of Fleſh or Bones, but only ſome of his Clothes.

3. There are four Sorts of *Damps*; the firſt is the ordinary Sort: The external Signs of its Approach are the *Candles* burning orbicular, and the Flames leſſening by Degrees, until they quite extinguiſh; the internal, Shortneſs of Breath. I never heard of any great Inconvenience which any one ſuffered by it, who eſcaped Swooning: Thoſe that ſwoon away, and eſcape an abſolute Suffocation, are, at their firſt Recovery, tormented with violent Convulſions; the Pain whereof, when they begin to recover their Senſes, cauſeth them to roar exceedingly. The ordinary Remedy is to dig a Hole in the Earth, and lay them on their Bellies, with their Mouths in it; if that fail, they tun them full of good Ale; but if that fail, they conclude them deſperate. I have known ſome who have been recovered after this Manner (when ſome of their Companions have, at the ſame Time, died) that told me, they found themſelves very well, within a little Time after they had recovered their Senſes, and never after found themſelves the worſe for it. By Mr. Jeſſop, n. 117. p. 391.

They call the ſecond Sort the *Peaſe-Bloom Damp*; becauſe, as they ſay, it ſmells like *Peaſe-Bloom*: They tell me, it always comes in the Summer-time; and thoſe Grooves are not free which are never troubled with any other Sort of *Damps*. I never heard that it was mortal; the Scent perhaps freeing them from the Danger of a Surprize: But, by Reaſon of it, many good Grooves lie idle at the beſt and moſt profitable Time of the Year, when the *ſubterraneous Waters* are at the loweſt. They fancy it proceeds from the Multitude of red Trefoyle Flowers, by them called Honey-Suckles, with which the Lime-Stones Meadows in the *Peak* do much abound.

The third is the ſtrangeſt and moſt peſtilential of any, if all be true which is ſaid concerning it; thoſe who pretend to have ſeen it (for it is viſible) deſcribe it thus: In the higheſt Part of the Roof of thoſe Paſſages which branch out from the main Groove they often ſee a round thing hanging, about the Bigneſs of a Foot-Ball, covered with a Skin of the Thickneſs and Colour of a Cobweb; this, they ſay, if by any Accident, as the Splinter of a Stone, or the like, it be broken, immediately diſperſeth itſelf, and ſuffocates all the Company. Therefore, to prevent Caſualties, as ſoon as they have eſpied it, they ſay, they have a Way, by the Help of a Stick and a long Rope, of breaking it at a Diſtance; which done, they purify the Place well with Fire, before they dare enter it again. I dare not avouch the Truth of this Story in all its Circumſtances, becauſe the Proof of it ſeems impoſſible, ſince, they ſay, it kills all that are likely to bear Witneſs to all the Particulars; neither dare I deny but ſuch a Thing may have been ſeen hanging on the Roof, ſince I have heard many affirm it. Our *Under-Ground Philoſophers* ſay, The Steam which ariſes from their Bodies and the Candles, aſcends into the higheſt Part of the Vault, and there condenſeth; and, in Time, has a Film grown round about it, which, at length corrupting, becomes peſtilential.

The 4th, which they alſo call a *Damp* (altho' how proper I will not argue) is that Vapour, which being touch'd by the Candle preſently takes Fire; and, giving a Crack like a *Gun*, produceth the like Effects, or rather thoſe of *Lightning*. A Fellow, they commonly call *Dobby Leach*, is, at this Day, a ſad Example of the Force of one of thoſe Blaſts in *Haſleberg-Hills*, having his Arms and Legs broken, and his Body ſtrangely diſtorted.

Captain *Wain* told me, he ſaw one of them in a *Bloomery* near *Peniſton*.

N. 119. p. 450. This *fulminating Damp* has lately done ſome Hurt in a Coal-Pit at *Wingerſworth*, two Miles from *Cheſterfield*.

The *Shaft* of the *Coal-Pit* is about 15 Yards deep, the Soil a ſtiff Mire, ſhaly about the Middle of the *Shaft*, dry at the *Bottom*, as they ſay, (tho' I obſerved ſome Moiſture about the Middle) and without any *Quarry* of *Stone*; the Stones in the Field about it are Grit-Stones. It lies almoſt at the *Bottom* of a riſing Ground, being encompaſſed with Hills on all Sides except towards the Eaſt, or rather South-Eaſt.

There are 3 Pits which lie almoſt in a direct Line, the middlemoſt of which is that we ſpeak of. There is alſo a fourth, which ſtands a little higher than the reſt.

From the *Bottom* run 4 *Binks*, as they call them, 4 Yards wide, and 40 Yards long; except that in which they meet the fiery Damp, which wants 4 or 5 Yards of its due Length.

The *Bink*, in which the Damp is, is the fartheſt from the Air which is communicated from the other *Pits*.

The *Soil* of this *Bink* (as they tell me) is a ſtiff Clay; neither can they find in it the Sign of any *Mineral*, except *Coal* and *Shale*. The *Coal*, they ſay, is abſolutely free from the *Pyrites*, with which moſt of our *Coals* are infected.

The *Bink*, in which the *Damp* is, was wrought forward 20 Yards on *Whitſon-Monday*, 1675, when *Geo. Mitchell* (one of my Informers) going in to fetch ſome of his Tools, with a Candle in his Hand, and coming within 4 or 5 Yards of the further End, found himſelf, on a ſudden, he knew not how, inviron'd with Flames. His Face, his Hands, his Hair, and a great Part of his Clothes, were very much burnt. He heard very little Noiſe, altho' one *Edward Mitchell*, who was working at the ſame Time in another *Bink*, told me, that both he, and all thoſe that ſtood above Ground, heard a very great one, like a Clap of Thunder; and that the Earth ſhook ſo that he was afraid the Roof would have fallen in and buried him.

This being the firſt Accident of this Nature, thoſe without ran in a great Amazement, with their Candles in their Hands, to ſee what the Matter was, which were twice extinguiſh'd, but held in upon the 3d Lightning: They ſaw nothing, but met with intolerable Stench of Brimſtone, and an Heat as ſcalding as an Oven half-heated, (for that was their Expreſſion) which forced them very ſpeedily to quit the Place.

Notwithſtanding this they wrought forwards for about 3 Weeks, and carried it on till betwixt 30 and 40 Yards, until one *Henry Turnelly* met with the ſame Accident which had formerly befallen *Mitchell*, and *Mitchell* had alſo the Misfortune to have his Share in this; for, being by chance under *Ground* at the Mouth of the *Bink*, he was ſhot forth for about 2 or 3 Yards, and had his Head broken, and his Body bruiſed againſt the further Side.

About a Week after *Edward Mitchell*, another of my Informers, adventuring in again, met with the ſame Misfortune, and was worſe ſcorched than any of the reſt.

The things I chiefly took notice of were theſe:

(1.) That thoſe who were in the *Bink*, whilſt it was fired, never heard any more Noiſe than that which was uſually made by a Flaſh of Gun-powder in the open Air, although thoſe in the other *Binks* and without heard a very great one.

(2.) It ſhot off the *Turn* at the Mouth of the Pit, and ſmall Coals, with other Rubbiſh from the Bottom, into the Air to a conſiderable Height.

(3.) They could perceive no Smell before the Fire, but afterwards a very ſtrong Smell of Brimſtone.

(4.) They uſed to go with their *Candles* low, as near as could be to the Bottom, becauſe they perceived the Vapour to lie towards the Roof; which, if they held their Candles higher than ordinary, they could ſee deſcend like a black Miſt, and catch hold of the Flame, lengthening it to two or three Handfuls; which would nevertheleſs burn after the uſual manner, without any further Miſchief, if they ſuddenly held down their Hands cloſe to the Ground.

(5) The *Flame* would continue in the *Vault* for 2 or 3 Minutes after the *Crack*; the laſt time, which was the moſt violent, they thought it continued about *half a Quarter* of an *Hour*.

(6.) The Colour of the *Flame* was blue, and very bright, ſomething inclining towards green.

(7.) Altho' they told me they were ſenſible of no Smell before the Kindling of the Vapour, yet the *Colliers Clothes*, that worked in the adjoining Pits, ſmelt very ſtrong of Brimſtone; which makes me ſuſpect all the Pits to be infected, altho' the Air ſecures them from Miſchief. Their Inſenſibility I aſcribe to the Cuſtom.

To the Queries ſuggeſted by Mr. *Boyle*, I anſwer as followeth:

[1.] That *Damps* are generally obſerv'd to come about the latter End of *May*, and continue during the Heat of Summer; and in thoſe Places, which have *Damps* all the Year long, yet they obſerve them to be moſt violent at that Seaſon: And I could meet with no other certain Rule for any *periodical Returns*, except this *annual*; altho' it be certain, they do often return in the ſame Summer.

[2.] I never heard of any *Damps* that kindled of themſelves; altho' I have been told, that in ſome Places they have been kindled by the Motion of the Sled in which they draw their Coals.

[3.] Damps generally are held to be heavier than the Air; but this was manifeſtly lighter, for it lay towards the Top of the Bink.

[4.] Upon the breaking of the *fulminating Damp* there proceeded a dark Smoke, of the Smell and Colour of that which proceeds from Gun-powder fired.

5. Many *Damps* are ſeen, but many alſo are not ſeen; which, whether they be viſible or no, is hard to tell, but I ſuppoſe all would be viſible, had we a convenient Light to view them by; becauſe, be they either thicker or thinner than the Air, that Denſity or Thinneſs will occaſion a Refraction, and that muſt needs render them viſible.

6. Some *Damps* will quite extinguiſh all thoſe Fires that are let down into them, be they never ſo many ſucceſſively, or never ſo great; and Fire is obſerved to be ſo far from *curing*, that it often creates *Damps* in Places not otherwiſe ſubject to them. Indeed they are a preſent Remedy, if you can ſo order them as, by their Help, to make a Circulation of the Air through the infected Place; otherwiſe they do Hurt; and thoſe *Grooves* wherein they are forced to break their Rocks by the Help of great Fires, are ſeldom free from *Damps*.

7. Men uſually work in Places infeſted either by the fulminating or other *Damps*, after they ſuppoſe the *Vapour* ſpent.

8. *Damps* are common both in wet and dry Ground; but I cannot tell in which moſt.

9. *Damps* are obſerved to be moſt peſtilential, and to kill the ſuddeneſt, that are in *Grooves* not ſtirred for many Years, eſpecially if ſuch *Grooves* have formerly had great Fires in them.

10. The general Opinion of our Workmen is, that there are ſome *Damps* which kill by Reaſon of the noiſome *Steam*, and others meerly by Want of *Air*; which latter Opinion I have heard diſallowed by the more experienced Sort: For they ſay, that there is no *Groove* that wants Air, be it never ſo deep; but the Air *ſtagnating* in very deep *Grooves* or *Pits*, the groſſer Parts muſt needs, at length, ſeparate themſelves by their own Weight, and ſubſiding to the *Bottom*, there corrupt, and conſequently get *malignant Qualities*, eſpecially in the *Summer-time*, when the Sun promotes the *Fermentation*. Beſides this, the ſtanding *Air* being in a ſhort Time filled with the *Vapours* ariſing from Men's Bodies and the *Steams* of *Candles*, and paſſing ſo often thro' the Lungs of the *Workmen*, is quickly rendered unfit for that Uſe (whatſoever it is) to which *Reſpiration* is accommodated; and this they take to be the moſt frequent Cauſe of ordinary *Damps*.

Damps will often follow the *Water*, and particularly this Sort of fiery *Damp*, if I am rightly informed.

By Mr. Rog. Moſtyn, n. 136. p. 895.

4. The *Coal-Work* at *Moſtyn* in *Flintſhire* lies in a large Parcel of Woodland, which hath a great Fall, directly North, to the Sea-Side; but the Dipping or Fall of the *Coal*, partly croſſing the Fall of the Ground, is within a Point of due Eaſt, and lies 40, 50, and ſometimes 60 Yards under the Level of the Sea. This Work is upon a Coal of five Yards in Thickneſs, and hath been begun upon about 6 or 8 and thirty Years ago. When it was firſt found it was extream full of *Water*, ſo that it could not be wrought down to the *Bottom* of the *Coal*, but a *Witchet* or *Cave* was driven out in the Middle of it upon a *Level*, for gaining Room to work, and drawing down the *Spring* of *Water* that lies in the *Coal* to the Eye of the Pit; in driving of which *Witchet*, after they had gone a conſiderable Way under Ground, and were

ſcanted of *Wind*, the *Fire-Damps* did begin, by little and little, to breed, and to appear in *Crevices* and *Slits* of the *Coal* where *Water* had lain before the Opening of the *Coal*, with a ſmall *bluiſh Flame*, working and moving continually, but not out of its firſt *Seat*, unleſs the *Workmen* came and held their *Candles* to it, and then, being weak, the Blaze of the Candle would drive it, with a ſudden Fizz, away to another *Crevice*, where it would ſoon after appear blazing and moving as formerly. This was the firſt Knowledge of it in this Work, which the *Workmen* made but a Sport of, and ſo partly neglected it, till it had gotten ſome Strength; and then, upon a Morning, the firſt Collier that went down, going forwards in the *Witchet* with his Candle in his Hand, the *Damp* preſently darted out ſo violently at his Candle, that it ſtruck the Man clear down, ſinged all his Hair and Cloaths, and diſabled him for working a while after. Some other ſmall Warnings it gave them, inſomuch that they reſolved to employ a Man on Purpoſe, that was more reſolute than the reſt, to go down a while before them every Morning, to chace it from Place to Place, and ſo weaken it. His uſual Manner was to put on the worſt Rags he had, and to wet them all in *Water*, and as ſoon as he came within the Danger of it, then he fell down, grovelling on his Belly, and went ſo forward, holding in one Hand a long *Wand* or Pole, at the End whereof he tied Candles burning, and reached them by Degrees towards it; then the *Damp* would fly at them, and if it miſſed of putting them out, it would quench itſelf with a Blaſt, and leave an ill ſcented Smoke behind it. Thus they dealt with it till they had wrought the Coal down to the Bottom, and the *Water* following, and not remaining as before in the Body of it, among *ſulphureous* and *braſſy Metal* that is in ſome Veins of the Coal, the *Fire-Damp* was not ſeen nor heard of till the latter End of the Year 1675, which happen'd as followeth.

After long Working of this Coal, it was found upon the riſing Grounds, that there lay another *Roach* of Coal, at the *Depth* of 14 Yards under it, which proved to be 3½ Yards thick, and ſomething more *ſulphureous*. This encouraged us to ſink in one of the Pits we had formerly uſed on the 5 *Yards Coal*; and we ſunk down 20 Yards before we came to the ſaid *Roach*, in Regard it was at the *Sea-ſide*, and upon the loweſt of the *Dipp*, where the Rocks ſucceſſively thicken as they fall. As we ſunk the lower Part of it, we had many Appearances of the *Fire-Damp* in *watry Crevices* of the Rocks we ſunk thro', *flaſhing* and *darting* from Side to Side of the Pit, and ſhewing *Rainbow-colour-like* on the Surface of the Water in the Bottom; but upon drawing up of the Water with Buckets, which ſtirr'd the Air in the Pit, it would leave burning, till the Colliers at Work, with their Breath and Sweat, and the Smoke of their Candles thickened the Air in the Pit, and then it would appear again; they lighted their Candles in it ſometimes when they went out, and ſo in this Pit it did no further Harm.

But being deſirous to get the Work in ſome Forwardneſs before *Summer*, (when the *Heat* of the *Weather* at ſome Times, and the *Cloſeneſs* of the *Air* in foggy Weather at others, occaſions the *ſmothering Damp*) it was reſolved, for *Expedition-ſake*, and ſaving of ſome Charges, to ſink a Pit within the *Hollows* or *Deads* upon the *upper Work*, at 16 or 17 Yards Diſtance from the *firſt Pit*. This we proceeded in, 'till we came 6 or 7 Yards deep; then the *Fire-damp* began to appear as formerly, accompanying the *Workmen* ſtill as they ſunk; and they uſing the ſame Means as before, ſometimes blowing it out with a *Blaſt* of their *Mouth*, at other times with their *Candles*, or letting it blaze without *Interruption*. As we ſunk down, and the *Damp* got ſtill more and more Strength, we found that our Want of *Air* perpendicular from the Day was the great *Cauſe* and *Nouriſher* of this *Damp*; for the *Air*, that followed down into this *Pit*, came down at the firſt-ſunk *Pit*, at the fore-mention'd Diſtance, after it had been diſperſed over all the old *Hollows* and *Deads* of the former *Work*, that were filled up with *noiſome Vapours*, thick ſmothering Fogs, and in ſome Places with the ſmothering *Damp* itſelf. Nevertheleſs, we held on ſinking till we came down to 15 Yards, plying the Work Night and Day (except *Sundays* and *Holidays*) upon which Intermiſſion, the Pit being left alone for 48 Hours and more, and the *Damp* gaining great Strength in the *interim*, by that time the *Workmen* went down, they could ſee it flaſhing and ſhooting from ſide to ſide, like *Sword-Blades* croſs one another, that none durſt adventure to go down into the Pit. Upon this they took a Pole, and bound *Candles*, ſeveral times to the End of it; which they no ſooner ſet over the Eye of the Pit, but the *Damp* would fly up with a long ſharp Flame, and put out the *Candles*, leaving a foul Smoke each time behind it. Finding that theſe things would not allay it, they adventur'd to bind ſome *Candles* at a Hook, hanging at a Rope's End, that was uſed up and down in the Pit: when they had lower'd down theſe a little way into the *Shaft* of the Pit, up comes the *Damp* in a full body, blows out the Candles, diſperſeth itſelf about the Eye of the Pit, and burneth a great Part of the Men's Hair, Beards, and Clothes, and ſtrikes down one of them, in the mean time making a Noiſe like the Lowing or Roaring of a Bull, but louder; and in the end leaving a Smoke and Smell behind it, worſe than that of a Carrion. Upon this Diſcouragement theſe Men came up, and made no further Trial; after this the Water that came from it, being drawn up at the other Pit, was found to be blood-warm, if not warmer.

In this Juncture there was a Ceſſation of the Work for 3 Days; and then the *Steward*, thinking to fetch a Compaſs about from the Eye of the Pit that came from the Day, and to bring Wind by a ſecure way along with him, that if it burſt again it might be done without Danger of Men's Lives, went down, and took two Men along with him, which ſerved his turn for this Purpoſe. He was no ſooner down, but the reſt of the Workmen that had wrought there diſdaining to be left behind in ſuch a time of Danger haſted down after them; and one of them, more indiſcreet than the reſt, went headlong with his Candle over the Eye of the *Damp-pit*, at which the *Damp* immediately catch'd, and flew to and fro over all the Hollows of the *Work*, with a great Wind, and a continual Fire; and, as it went, keeping a mighty great roaring Noiſe on all Sides.

The Men, at firſt Appearance of it, had moſt of them fallen upon their Faces, and hid themſelves as well as they could, in the looſe *Sleck*, or *Small-coal*, and under the Shelter of Poſts; yet nevertheleſs the *Damp* returning out of the Hollows, and drawing towards the Eye of the Pit, it came up with incredible Force; the Wind and Fire tore moſt of their Clothes off their Backs, and ſinged what was left, burning their Hair, Faces, and Hands; the Blaſt falling ſo ſharp on their Skin, as if they had been whipt with Cords; ſome, that had leaſt Shelter, were carried 15 or 16 Yards from their firſt Station, and beaten againſt the Roof of the Coal and Sides of the Poſt, and lay afterwards a good while ſenſeleſs, ſo that it was long before they could hear or find one another. As it drew up to the Day Pit it caught one of the Men along with it, that was next the Eye, and up it comes with ſuch a terrible Crack, not unlike, but more ſhrill than a Cannon, that it was heard 15 Miles off, with the Wind; and ſuch a Pillar of Smoak, as darken'd all the Sky over head for a good while. The Brow of the Hill above the Pit was 18 Yards high, and on it grew Trees 14 or 15 Yards long; yet the Man's Body, and other Things from the Pit, were ſeen above the Tops of the higheſt Trees, at leaſt 100 Yards. On this Pit ſtood a Horſe-Engine of ſubſtantial Timber, and ſtrong Iron Work; on which lay a Trunk, or Barrel, for winding the Rope up and down, of above 1000 Pounds Weight; it was then in Motion, one Bucket going down, and the other coming up full of Water: This Trunk was faſtened to that Frame with Locks and Bolts of Iron; yet it was thrown up, and carried a good way from the *Pit*; and and Pieces of it, tho' bound with Iron Hoop and ſtrong Nails, blown into into the Woods about; ſo likewiſe were the two Buckets; and the Ends of the Rope, after the Buckets were blown from them, ſtood a while upright in the Air like Pikes, and then came leiſurely drilling down. The whole Frame of the Engine was ſtirr'd and mov'd out of its Place; and thoſe Men's Clothes, Caps, and Hats, that eſcaped, were afterwards found ſhatter'd to pieces, and thrown amongſt the Woods a great way from the Pit. This happened the 3d of *Feb.* 1675, being a Seaſon when other Damps are ſcarce felt or heard of.

5. About 2 Miles on the South-Eaſt of *Stony Eaſton*, at a Place nearly bordering to *Mendipp-Hills*, begins a Running of Coal conſiſting of ſeveral Veins, which extends itſelf towards the Eaſt about 4 Miles. There is much Working in this *Running*, and Fire-Damps continually there happen; ſo that many Men of late Years have been there kill'd, many others maimed, and a Multitude burnt; ſome have been blown up at the Work's Mouth; the *Turn-Beam* (which hangs over the *Shaft*) has been thrown off its Frame by the Force of it; and thoſe other Effects, whereof you had an Account from other Places, are generally found. The Middle and more Eaſterly Parts of this *Running* are ſo very ſubject to thoſe fiery Damps, that ſcarce a Pit fails of them; notwithſtanding which our Colliers ſtill purſue their Work; but, to prevent Miſchief, they keep their Air very quick, and uſe no Candles in their Works but a ſingle Wick, and thoſe of 60 or 70 to the Pound, which nevertheleſs give as great a Light there, as others of 10 or 12 to the Pound in other Places; and they always place them behind them, and never preſent them to the Breaſt of the Work.

By Mr. J. Beaumont, *Phil. Col.* n. 1. p. 6.

When any are burnt, the uſual Method they obſerve in their Cure is thus; They preſently betake themſelves to a good Fire, and ſending for ſome *Cow*'s hot Milk, they firſt bathe the burnt Places with that; when they have done this a while, they make uſe of an Ointment proper for Burnings, which the Maſters of the Works have always in a Readineſs for ſuch Chances, being furniſhed therewith, at the cheap Rate of 12 Pence the Pound, by a good old Woman living near the Works.

The Colliers aſſure me, that theſe Works are apt to take Fire all the Year, which it will freely do at any Time if a Candle be carry'd within Air: But moſt, and with moſt Violence, in the Winter, and chiefly in a *black Froſt*, when the Air runs beſt: That the Danger of Firing is alike both in wet and dry Grounds: And that there are no Fumes coming out of the Mouth of any Shaft which will be lighted by a Candle or Torch.

I have heard of one Damp here which took Fire of itſelf, and kindled the Vein of Coal, which burnt a conſiderable Time before it went out.

Our *Damps* lie as well towards the Bottom or Seal of the Work as towards the Roof, it being nothing but an inviſible *ſulphureous Breath* expanded through the whole Work.

I cannot perceive at the Mouth of any Shaft, or underſtand by any Workman, of any unuſual Wind or Current of Vapours coming from beneath. In wet Works there are many Times Bubbles on the Surface of Water there ſtanding, which will preſently take Fire if a Candle be held to them: But I cannot find that thoſe Bubbles are cauſed by any *ſubterraneous Breath*, but riſe from the Falling of Coal into the Water, or from Dropping of Water from the Roof, as we ſee they do in Ponds from Drops of Rain in the Summer.

I may here further acquaint you, as a Novelty, that this laſt Summer, 1679, two *Fire-Damps* happened in our *Lead-Mines* on *Mendipp-Hills*; but they were of ſo ſmall a Force that the Workmen received no Prejudice by them.

A Well and Earth in Lancaſhire, *taking Fire at a Candle, by Mr.* Tho. Shirly, n. 26. p. 482.

VIII. About the latter End of *Feb.* 1659, returning from a Journey to my Houſe in *Wigan*, I was entertained with the Relation of an odd Spring, ſituated in one Mr. *Hawkley*'s Ground (if I miſtake not) about a Mile from the Town, in that Road which leads to *Warrington* and *Cheſter*; the People of this Town did confidently affirm, that the Water of this Spring did burn like Oil.

When we came to the ſaid Spring (being 5 or 6 in Company together) and applied a lighted Candle to the Surface of the Water, 'tis true, there was ſuddenly a large Flame produced, which burnt vigorouſly: But obſerving that this Spring had its Eruption at the Foot of a Tree, growing on the Top of a neighbouring Bank, the Water of which Spring filled a Ditch that was there, and covered the burning Place, I applied the lighted Candle to divers Parts of the Water contained in the ſaid Ditch, and found, as I expected, that, upon the Touch of the Candle and the Water, the Flame was extinct.

Again, having taken up a Diſh full of Water at the *flaming Place*, and held the lighted Candle to it, it went out. Yet I obſerved that the *Water* at the burning Place did boil and heave like Water in a Pot upon the Fire, though my Hand put into it perceived it not ſo much as warm.

This Boiling I conceived to proceed from the Eruption of ſome *bituminous* or *ſulphureous Fumes*, conſidering this Place was not above 30 or 40 Yards diſtant from the Mouth of a *Coal-Pit* there: And indeed *Wigan*, *Aſhton*, and the whole Country for many Miles Compaſs, is underlaid with *Coal*. Then applying my Hand to the Surface of the *burning Place* of the *Water*, I found a ſtrong *Breath*, as it were a Wind, to bear againſt my Hand.

When the Water was drained away, I applied the Candle to the Surface of the dry *Earth*, at the ſame Point where the *Water* burned before; the *Fumes* took *Fire* and burned very bright and vigorous. The *Cone* of the *Flame* aſcended a Foot and an Half from the Superficies of the *Earth*: And the *Baſis* of it was of the Compaſs of a Man's Hat about the Brim. I then cauſed a Bucket full of *Water* to be poured on the *Fire*, by which it was preſently quenched. I did not perceive the *Flame* to be *diſcoloured* like that of *ſulphureous Bodies*, nor to have any manifeſt *Scent* with it. The *Fumes*, when they broke out of the *Earth* and preſs'd againſt my Hand, were not, to my beſt Remembrance, at all hot.

A ſubterraneal Fire in a Coal Mine at Newcaſtle, *by Dr.* Lucas Hodgeſon, n. 130. p. 762.

IX. This *ſubterraneal Fire* keeps no Analogy with other *Vulcano*'s: It increaſeth or decreaſeth according to the Subject it feedeth on; which is, for the moſt Part, a *Day-Coal* (as they call it, for the *upper Seam* of the *Coal* next expoſed to the Air) ſo that you may light a Candle at it in ſome Places; in other Places it is ſome Fathoms deep, according as the *Day-Coal* heightens or deepens.

No *Sal-Armoniack*, nor any thing like it, to be found, except where an actual *Fire* hath come. There being a Mixture of the *Steams* of *Sal-Armoniack* and *Sulphur* riſing together in moſt Places, it is hard to diſtinguiſh them; for though the *Flowers* of *Brimſtone* ſeem to riſe firſt, yet there is commonly a Cruſt of *Sal-Armoniack* under them.

There is a *milky Subſtance*, which is found no where but where the *Sal-Armoniack* and *Sulphur* are totally gone; and the *acid* Part, or *aluminous Spirit*, of that white Maſs will alſo take Wing by the Increaſe of the *Fire*, leaving a *Caput. Mort.* dry, ſtiptick, and as hard as Stone; yet I account that a Pound of this Maſs, before the *Fire* preſs too much upon it, will go near to afford by *Solution*, *&c.* Half a Pound of tolerable *chryſtalline Alum*.

The neighbouring Soil differs little from other Grounds with us, having neither *common Salt* nor *Nitre* in it; for though there be a *Salt-Well* with us, yet it is both on the other Side of *Tyne* and a conſiderable Diſtance from the *Fire*.

I have induſtriouſly obſerved the *Springs* that are near the *Fire*, and find none of them that give the leaſt Suſpicion of *Sal-Armoniack*. The *Water* that runs from the adjacent *Collieries* is *vitrioline*, giving as deep a Tincture with *Galls* as *Scarborough-Spaw*. In a Word, it differs nothing from the *Waters* that ordinarily drown our *Collieries*, and coſt our *Coal* Owners ſo much to be quit of them. The other *Springs*, moſt of which are dry this Year (1676) are of ordinary Uſe, containing no *Mineral Salts* in them. But I hope you will ceaſe to wonder, that *Coal* ſhould produce a *volatile Salt* by the Action of the *Fire*, ſeeing I have gathered *Sal-Armoniack* from a burning *Brick-Kiln*, where nothing but *Clay* and *Coal* are burnt together, and I hope none will expect the *volatile Salt* in the *Sal-Armoniack* from ordinary *Clay*. The Reaſon which firſt prompted me to ſeek this Salt there, was that the Smell of the *Kiln* did ſomewhat reſemble that of the *ſubterraneal Fire*. There is alſo a Sort of *Mineral* we call a Slate, which is partly *Coal*, partly *Alum-Stone*, partly *Marcaſite*, which, being laid up in Heaps and burnt, are uſed for hardening the Coal-Ways; upon theſe Heaps, whilſt burning, I have often gathered both *Brimſtone* and *Sal-Armoniack*.

When I poured cold Water upon the powder'd *Marcaſite*, it produced a *vitrioline Water*, but no Heat.

As to the Reſemblance betwixt this *Sal-Armoniack* and that which comes from Mount *Ætna*, where no Coals are ſuppoſed to be, whence it ſeems to follow, that our *volatile Salt* may proceed from ſomewhat elſe than Coal; to which Difficulty I anſwer, that when I deduced ours from Coal, I did not exclude other *bituminous* Subſtances that are analogous to it, of which I ſuppoſe the Country where Mount *Ætna* is affordeth no inconſiderable Quantity; neither will it follow that no Coals have been wrought, therefore there are none; and if Trial hath been made, and no Coals found, yet it will be a Doubt ſtill whether thoſe Trials have been ſufficient. However it be, yet I think it were not impertinent (by the Way) to enquire, whether the the ſagacious *Venetians* may not be beholden to Mount *Ætna*, or ſome other *ſubterraneal Fires*, for the great Quantity of *Sal-Armoniack* they ſell to our Merchants; for this *Fire* affordeth no inconſiderable Quantity thereof, eſpecially in dry Weather.

Though it may ſeem incredible to ſome that black Coal ſhould yield a *white, ſnowy, volatile Salt*, yet they that know that all *volatile Salts* whatever may be freed from their *Fætor* and intenſe Colour, by tranſmuting them into a *Sal-Armoniack* by the Mediation of an *Acid*, as Spirit of Salt, Spirit of *Vitriol*, *Alum*, &c. and then ſubliming them till they be white, will ceaſe to doubt of this Matter. The Reaſon of which Change, I preſume, is, becauſe, though theſe *volatile Salts* carry over always ſome of the *fætid Oil* with them while in a State of *Volatility*, yet being thus, in a Manner, fixed, the *fætid Oil* muſt neceſſarily, by Force of Fire, riſe firſt, leaving the ſubſequent *compound Salt*, or *Sal-Armoniack*, without Smell; though it is ſtill a Doubt whether the *volatile Salt* is *better* or *worſe* for this Labour.

We have no *petreſcent* Springs near us; but there is a *Cave* ſome Miles off, at the fartheſt End of which few have been, from the Roof of which hang large Lumps of *petrified Water*, like *Icicles*, ſome of them reaching down to the Ground like Pillars; theſe *Icicles* are good *Limeſtone*, as I have tried.

An Eruption of Fire near Fierenzola; *By* Dr. Rob. St. Clair. n. 245. p. 378.

X. I have lately received an Account from my Brother, that on a Side of one of the *Appennine Mountains*, half way betwixt *Bologna* and *Florence*; near a Place called *Petra Mala*, about 5 Miles from *Fierenzola*, there is a Spot of Ground about 3 or 4 Miles Diameter, which inceſſantly ſends up a Flame riſing very high, without Noiſe, Smoak, or Smell; yet it gives a very great Heat, and it has been obſerved to be thus in all times, except of great Rains, which put it out for a time; but, when that is over, it burns with greater Vigour and Heat than before. The Sand about it, when turned up, ſends up a Flame; but within 3 or 4 Yards of it there grows Corn all round about; for it continues always in the ſame Spot.

This Flame ſeems to proceed from a Vein of *Bitumen* or *Naphtha*, that *Crops* (as the *Miners* call it) only here; which, when by Plowing or ſome other Accident the upper Cruſt has been turned up, was kindled into a Flame by the Heat and Agitation of the Air, as other *Salino-Sulphureous* Bodies are, of which 'Squire *Boyle*'s *Phoſphorus* is a particular Inſtance. The like *Spontaneous Aſcenſion* is ſeen in many *Mineral* Subſtances; but none, that I know of, ſo quick in its Production, or ſo laſting, as this is; the whole Wood and Fields having been deſtroyed by them. The Neighbours there have been ſo little curious to obſerve it, that they believed there was a great Hole in the Flame-Place; but he found it to be firm Ground. Neither does any there remember when and upon what Occaſion it firſt began. The *Flaming Well* near *Wigan* ſeems to proceed from a Cauſe much like this, in which you may boil an Egg, and upon the approaching of a lighted Candle, it takes Fire; both ſeem to proceed from a *Naphtha* or *Subtile Bitumen*; only that in a hotter Country, and being in a dryer Soil, is more ſubtile and inflammable; juſt as the *Petroleum* which is to be found in *Italy* is a White like *Spirit* of *Turpentine*, and is more penetrating than the *Petroleum* which is to be found in the Northern Countries; an Inſtance of which we have in a *Well* two Miles diſtant from *Edinburgh*, called the *Baulme-Well*, of a black red Colour and very thick; but, being diſtilled, does in Colour, Taſte and Smell, reſemble that of *Italy*.

The *Spontaneous Aſcenſion* of the *Naphtha* ſeems to be made out by the Smell that our *Bitumen* near *Edinburgh* yields, being moſt like *Coal-Smoak*. There are three ſuch Fires on the ſame Hills that are extinguiſh'd in the Summer, but burn in the Winter; the Reaſon of which I judge to be, that the Bowels of the Earth, being cooler in the Summer than in Winter, do not ſend forth that Quantity of thoſe *Subtile Exhalations*, as may be ſufficient to maintain a Flame in Summer; but in Winter the Bowels of the Earth being hotter (which is made evident by the ſmoaking of Springs in Winter, and not in Summer, and the Experience of Miners) greater Plenty of Steams are ſent forth, which in the Air are agitated into a Flame, the brisk Motion of the Parts one againſt another being promoted by the Subtilty and brisk Motion of the *Aerial* Particles, *quæ mutuas dant operas*.

An hiſtorical Account of the Eruptions of Mount Ætna; *by Mr.* Oldenburgh. n. 48 p. 967.

XI. To paſs by what is related by *Beroſus*, *Orpheus*, and other leſs credible Authors, about the Eruptions of this Mountain, both at the time of the Ingreſs of the *Ionian Colonies* into *Sicily*, and that of the *Argonauts* (which latter was in the 12th *Age* before the *Chriſtian* Account;) we ſhall firſt take notice of that which happen'd at the time of the Expedition of *Æneas*; who, being terrify'd with the Fire of this then burning Mountain, left that Iſland; whereof *Virgil* gives a notable Deſcription.

Lib. 3. Æneid.

After this, we find in *Thucydides*, that in the 76 *Olympiad*, which is about 476 *before Chriſt*, there was another Fire; and about 50 Years after that another.

Then, in the time of the *Roman Conſuls*, there happen'd 4 *Eruptions* of *Ætna*, recorded by *Diodorus Siculus*, and *Polybius*.

The next was in the time of *Julius Cæſar*, related by the ſaid *Diodorus*, to have been ſo fierce, that the Sea about *Lipara* (an Iſland near *Sicily*, by its fervent Heat burnt the Ships, and killed all the Fiſhes thereabout.

Another we read of in the Reign of *Caligula*, about 40 Years *after Chriſt*; which was ſo dreadful, that it made that Emperor, then being in *Sicily*, to fly for it.

About the Martyrdom of the *Romiſh* S. *Agatha* it burned again very fiercely; though ſome ſay, that by virtue of her Interceſſion it was ſtay'd from reaching *Catanea*.

Again it burnt *A. C.* 812, in the Reign of *Charles M.*

Then from the Year 1160 to 1169, all *Sicily* was ſhaken with many terrible Earthquakes; and the *Eruptions* of the ſame Mountain deſtroy'd a vaſt Tract of inhabited Land round about it, and reach'd as far as *Catanea*; the Cathedral of which it deſtroyed, and the religious Men living in it.

Again, in the Year 1284, there happened another terrible Fire about the time of the Death of *Charles*, King of *Sicily* and *Arragon*.

A. 1329, until 1333, there was another.

A. 1408, another.

A. 1444, another, which laſted till 1447.

A. 1536, another, which laſted a Year.

A. 1633, another, continuing ſeveral Years.

A. 1650, it burnt on the North-Eaſt Side, and vomited ſo much Fire, that by the fiery Torrents cauſed thereby, great Devaſtation was made; as *Kircher* relates in his *Mundus ſubterraneus*; whoſe Aſſiſtance we have alſo made uſe of, in the foregoing *Chronology*, together with that of *Philotheus*.

The ſame Author, having been in *Sicily* himſelf, obſerveth, that the People of *Catanea*, digging for *Pumice-Stones*, do find at the Depth of 100 *Palmes* (which is about 68 Feet) Streets paved with Marble, and many Footſteps of Antiquity; an Argument, that Towns have ſtood there in former Ages, which have been overwhelmed by the Matter caſt out of this Mountain. They have alſo found ſeveral Bridges of *Pumice-*

Stones, doubtleſs made by the Flux of fiery Torrents, the Earth being very much raiſed ſince.

An Eruption of M. Ætna in 1669, by ſome English Merchants. n. 51. p. 1028

XII. There was for the Space of 18 Days before this Fire broke out a very thick dark Sky in thoſe Parts, with Thunder and Lightning, and frequent *Concuſſions* of the Earth; which the People make terrible Reports of, tho' I never ſaw nor heard of any Buildings caſt down thereby, ſave a ſmall Town, or Village called *Nicoloſi*, about half a Mile diſtant from the new Mouth, and ſome ſuch other ſlight Buildings among thoſe Towns, that were after over-run by the Fire. Beſides, it was obſerv'd, that the old Top or Mouth of *Ætna* did, for 2 or 3 Months before, rage more than uſual; the like of which did *Volcan* and *Strombolo*, two burning Iſlands to the Weſtward: And the Top of *Ætna*, much about the ſame time, has ſunk down into its old *Vorago* or Hole, in that 'tis agreed by all that had ſeen this Mountain before, that it was very much lower'd.

It firſt broke out on the 11th of *March*, 1669, about two Hours before Night, and that on the South-Eaſt ſide, or Skirt of the Mountains, about 20 Miles between the *Old-Mouth*, and 10 Miles from *Catanea*. At firſt it was reported to advance 3 Miles in 24 Hours; but at our being there (*viz. April* 5.) when we were come within a ſhort Mile of *Catanea*, it ſcarce moved after the rate of a Furlong a Day; and after this Degree of Progreſs it continued for 15 or 20 Days after, paſſing under the Walls of *Catanea*, a good way into the Sea: But about the latter end of this Month, and the beginning of *May*, (whether it was, that the Sea could not receive this Matter faſt enough, or rather that the Mouth above did caſt out a larger Quantity) it bent all its Force againſt the City; and having wrought itſelf up even with the Walls thereof, over it paſſed in divers Places: but its chief Fury fell upon a very pretty Convent, which was that of the *Benedictines*, having large Gardens and other Grounds betwixt them and the Wall; which, when it had filled up, it fell with all its Force on this Convent, where it met with ſtrong Reſiſtance; which made it ſwell (as uſually it did, where it met with any Obſtruction) almoſt as high as the higher Shops in the old *London-Exchange*; this Convent being built much after that Faſhion, though conſiderably bigger. Some Parts of this Wall were driven in, whole and entire, almoſt a Foot; as appeared by the riſing of the Tiles in the midſt of the Floor, and bending of the Iron-Bars that went croſs above. And 'tis certain, had this Torrent fallen in ſome other Part of the Town, it would have made great Havock amongſt their ordinary Buildings; but here its Fury ceaſed upon the 4th of *May*, running henceforward in little Channels or Streams, and that chiefly into the Sea. It had overwhelmed in the up-land Country, ſome 14 Towns and Villages, whereof ſome were of good Note, containing 3 or 4 thouſand Inhabitants, and ſtood in a very fruitful and pleaſant Country, where the Fire had never made any Devaſtation before: But now there is not ſo much as any Sign where ſuch Towns have ſtood; only the Church and Steeple of one of them, which ſtood alone upon an high Ground, does ſtill appear.

As to the Matter which thus ran it was nothing elſe but divers kinds of *Metals* and *Minerals*, render'd liquid by the Fierceneſs of the *Fire* in the *Bowels* of the Earth, boiling up, and guſhing forth, as the Water doth at the Head of ſome great River; and having run in a full Body, for a Stone's Caſt, or more, the Extremity thereof began to cruſt and curdle, becoming, when cold, thoſe hard porous Stones, which the People call *Sciarri*, having the neareſt reſemblance to huge Cakes of Sea-Coal, full of a fierce Fire. Theſe came rolling and tumbling over one another; and, where they meet with a Bank, would fill up and ſwell over, by their Weight bearing down any common Building, and burning up what was combuſtible. The chief Motion of this Matter was forward; but it was alſo dilating itſelf, as a Flood of Water would do on even Ground, thruſting out ſeveral Arms, or Tongues, as they call them.

About 2 or 3 a-clock in the Night we mounted an high Tower in *Catanea*, whence we had a full View of the *Mouth*, which was a terrible Sight; *viz.* to ſee ſo great a Maſs, or Body of meer Fire. Next Morning we would have gone up to the *Mouth* itſelf, but durſt not come nearer than a Furlong off, for fear of being overwhelmed by a ſudden Turn of the Wind, which carried up into the Air, ſome of that vaſt Pillar of Aſhes, which, to our Apprehenſion, exceeded twice the Bigneſs of *Paul's Steeple* in *London*, and went up in a ſtrait Body to a far greater Height than that; the whole Air being thereabout all covered with the lighteſt of thoſe *Aſhes*, blown off from the Top of this Pillar: And from the firſt breaking forth of the *Fire*, until its Fury ceaſed (being 54 Days) neither Sun nor Star were ſeen in all that Part.

From the outſide of this Pillar fell off great Quantity of Stones, but none very big; neither could we diſcern any *Fire* in them, nor come to ſee where the fiery Stuff broke out, there being a great Bank, or Hill of *Aſhes* betwixt it and us. At the Mouth, whence iſſued the *Fire*, or *Aſhes*, or both, was a continual Noiſe, like the beating of great Waves of the Sea againſt Rocks, or like Thunder afar off; which, ſometimes, I have heard here in *Meſſina*, though ſituated at the Foot of high Hills, and 60 Miles off. It hath alſo been heard 100 Miles Northward of this Place in *Calabria* (as I have been credibly inform'd) whither the Aſhes have been alſo carried: And ſome of our Seamen have alſo reported, that their Decks were covered therewith at *Zant*, though it is likely not very thick.

Vide Cap. I. § 39.

About the middle of *May* we made another Journey thither, where we found the Face of things much alter'd; the City of *Catanea* being 3 Quarters of it compaſſed round with theſe *Sciarri*, as high as the Top of the Walls, and in many Places it had broken over. The firſt Night of our Arrival, a new *Stream* or Gutter of *Fire* broke forth among ſome *Sciarri*, which we were walking upon an Hour or two before, and they were as high as to be even with the Top of the Wall. It poured itſelf down into the City in a ſmall Gutter of about 3 Foot broad, and nine Foot long, of meer Fire, the Extremities ſtill falling off into thoſe *Sciarri*; but this Stream was extinct by the next Morning, though it had filled up a great void Place with its *Sciarri*. The next Night was a much bigger Channel diſcovered, pouring itſelf over another Part of the Wall into the *Caſtle-Ditch*, which continued (as we were inform'd) ſome

Days after our Departure.. Divers of thoſe ſmall Rivulets did run at the ſame time into the Sea.

It was obſerved, that thoſe Streams of Fire never grew broader, nor viſibly longer, nor moved out of the Place they were ſeen in, which puts us a little more to examine their working; and we did conclude, that not only then, but in the Fury alſo of its running, it made itſelf certain cruſted Gutters to run in, to keep itſelf, as it were, from the Air, which by degrees did cool and fix it; as more plainly appeared above at the Mouth, where, the firſt time of our going thither, we found the *Sciarri* generally thus cold and fix'd. And hence alſo it might proceed, that theſe live *Sciarri*, meeting with any Bank or high Ground, would puff and ſwell up, till they had overcome it: ſo that in many places, eſpecially under the Walls of *Catanea*, were Valleys of thoſe *Sciarri*, and the Fire never broke forth, or diſcovered itſelf in thoſe Streams, until it had gained its Height; for thoſe Rivulets ever went declining.

Having ſpent 2 Days about *Catanea*, we again went up to the Mouth, where now, without any Danger of *Fire* or *Aſhes*, we could take a free View both of the old and new *Channel* of the *Fire*, and of that great Mountain of Aſhes caſt up. That, which we gueſs to be the old *Bed* or *Channel*, was a three-corner'd Spot of about 2 *Acres*, with a Cruſt or *Sciarri* at the *Bottom*, and upon that a ſmall Cruſt or Surface of *Brimſtone*. It was hedged in on each Side with a great Bank, or Hill of *Aſhes*; and behind, and at the upper End, roſe up that huge Mountain of the ſame Matter. Between thoſe two Banks the Fire ſeems to have had its Paſſage. At the upper End in the Nook, upon a little Hillock or cruſted *Sciarri*, was a *Hole* about 10 Foot wide, whence it is probable the Fire iſſued, and it might have had ſeveral other ſuch Holes ſince, either cruſted over, or covered with Aſhes. At the Bottom of this Hole the Fire was ſeen to flow along, and below it was a *Channel* of *Fire*, beneath that Surface of *Sciarri*, which being cleft a-top for ſome Space, we had an eaſy and leiſurable View of the *Metal* flowing along, whoſe *Superficies* might be a Yard broad, tho' poſſibly it carried a great Breadth underneath, the Gutter going ſloping. What Depth it had we could not gueſs; it was impenetrable by Iron Hooks, and other Inſtruments we had. We were very deſirous to have got ſome of this Matter at the *Spring-Head*, but we could penetrate no more into it, than with one's Finger into the Palm of the Hand. 'Tis likely that ſome Running may have been more yielding than we found this. From *Channel*, but eſpecially from that Hole above it, iſſued great Store of a ſtrong *ſulphurous Smoak*, wherewith ſome of our Company were, at firſt, almoſt ſtifled, thro' Inadvertency. About once in a Quarter of an Hour there would riſe a Pillar of Smoak, or Aſhes, but nothing comparable to the former, which ſeemed to come from the middle Top of that new-made Mountain.

At this our laſt being at *Catanea* we found the People buſy in barricading the Ends of ſome Streets and Paſſages, where they thought the Fire might break in; and this they did by pulling down the old Houſes thereabouts, and laying up the looſe Stones in manner of a Wall, which, they ſaid, would reſiſt the Fire, as not being mixt with *Lime*; though it was the great Weight and

Force of that fiery Matter in preſſing forward, and not its burning, that overthrew the Buildings, as plainly appeared in the Convent of the *Benedictines*, and in the *Town-walls*, where the great Deluge of Fire did pour itſelf; it not breaking into the City, but pouring itſelf over the *Walls*, as hath been ſaid.

Unto this very time 'tis ſaid to have run a Mile into the Sea, and as much in Front, tho' it was much leſs when we were there, The Shore goes gently declining; having at the Extremity of the *Sciarri* about 5 Fathoms, and about half as much they are above Water. The Superficies of the Water, for 20 Foot or more of thoſe Rivulets of Fire, was hotter than to endure one's Hand in it, tho' deeper it was more temperate; and thoſe live *Sciarri* ſtill retained their Fire under Water, as we ſaw, when the Surges of the Sea retreated back in their ordinary Reverberations.

The general Face of theſe *Sciarri* is, in ſome reſpect, not much unlike, from the Beginning to the End, to the River of *Thames* in a great Froſt, at the Top of the Ice above Bridge; I mean, lying after ſuch a rugged manner in great Flakes: but its Colour is quite different, being moſt of a dark duſky Blue, and ſome Stones, or Rocks, of a vaſt Bigneſs, cloſe and ſolid.

But notwithſtanding their *Ruggedneſs*, and Store of *Fire*, which we could ſee glowing in the Clefts and Cavities, we made ſhift to ramble over a good part of them; as 'tis ſaid alſo, that People would do the ſame in its greateſt Violence of Burning: For as thoſe live *Sciarri*, and thoſe *Rivers* of *Fire* themſelves, were ſo tough and impenetrable as to bear any Weight; ſo the Superficies of the *Sciarri* might be touched and handled, the *Fire* being inward, and not to be diſcerned but near-hand, eſpecially in the Day-time. And 'twas ſomewhat a ſtrange Sight, to ſee ſo great a River come ſo tamely forward; for, as it approached unto any Houſe, they not only, at good leiſure, removed their Goods, but the very Tiles and Beams, and what elſe was moveable.

I ſhall add, That the whole Country, from the very *Walls* of *Catanea* to 20 Miles on this ſide, is full of thoſe old *Sciarri*, which former *Eruptions* have caſt forth, tho' the People remember none ſo big as this laſt, or that burſt out ſo low. This Country is, notwithſtanding, well cultivated and inhabited; for length of time hath either mollified much of thoſe old *Sciarri*, or new Moulds or Aſhes have overgrown them; tho' there ſtill remains much Country, which, it may be, will never be made ſerviceable.

What is the perpendicular Height of this Mountain I cannot learn. It cannot, perhaps, be rightly taken, being ſo ſubject to alter its Height and Shape: But it is a very goodly Mountain to look upon, as one paſſes by Sea to the Eaſtward, ſtanding alone by itſelf, riſing from the very Shore, and, at ſhorteſt Paſſage, is reckoned twenty Miles up to the Top, tho' from *Catanea* it hath thirty Miles as before.

n.52.p.1041 A good Quantity of *Aſhes* being taken up in divers Parts of and about *Ætna*, ſome at the Top or the Mouth of the new made Mountain, ſome a Mile off, ſome four, ſome ten Miles, ſome but half a Mile diſtant, and others on the Skirts of the ſaid Mountain; the four firſt were found very dry like Duſt; but the two latter were very moiſt, though in *Sicily* (as we are inform'd) they have lain a good while expoſed to the Heat of the Sun; beſides that the two laſt differ from one another, in that one ſort of them conſiſts of hard and ſmall Lumps, the other of very ſoft dirty Grains; yet both moiſt, and of a very vitriolate Taſte.

Some of the *Sciarri* are coarſer, taken up at ſome Diſtance from the Mouth; and of theſe ſome black, with a Cruſt of *Brimſtone*; ſome of a red Hue; others are finer; and ſaid to be got out of the Gutters of Fire at the very Mouth. Both theſe kinds are light; but then there is a third ſort of Stone, very ſolid and ponderous, which ſeems to be made up of a Conflux of divers Minerals melted together.

The Fire ſpread about three Miles in breadth, and ſeventeen Miles in length.

An Account of ſeveral Burning Mountains *in the* Molucca *Iſlands, ſent to M.* Nich. Witſen; *by* --- n.206. p.49.

XIII. 1. When the Eaſterly Wind had blown about 6 or 7 Weeks, till, as I gueſs, about the fourth of *June*, 1693, the Mountain in the Iſland *Sorea* began early in the Morning, about Day-break, to caſt out more Fire than ordinary, which continued for 5 or 6 Days; during which it was dark and cloudy Weather: till at laſt it brought forth, not only a moſt prodigious Flame, but alſo ſuch a black and ſulphurous Vapour, that the Inhabitants of *Hiſlo* (being a Village in the weſtern Part of the Iſland, and neareſt to the Opening of the Mountain) were wholly covered by it; and afterwards followed a whole Stream of burning Brimſtone, which conſumed many that could not eſcape. Afterward the Inhabitants perceived, that a Part of the ſaid Mountain was ſunk down; and three or four Days after another Part; and ſo from time to time, until the burning Lake was become almoſt as great as half of the Iſland: Wherefore the Inhabitants went on board of their Veſſels and Boats, from whence they perceived that huge great Pieces of the Mountain fell into this fiery Lake, as into a bottomleſs Pit, with a moſt prodigious Noiſe, as if a whole Cannon were diſcharged. But the moſt remarkable thing was, that the more vehement the Fire was, the leſſer the Iſland was ſhaken. The Inhabitants of another Town called *Woroc*, upon the Eaſt-ſide of the Iſland, not thinking themſelves in ſo great Danger, (the Opening, or fiery Lake being yet at ſome Diſtance) remained a Month longer, untill they ſaw the ſame continually approaching them. They obſerved that when great Pieces fell down, and that the Lake became wider, the Noiſe was ſo much the greater: So that they ſaw no likelihood, but that all the Iſland would be ſwallow'd up. Wherefore they unanimouſly tranſported themſelves to *Banda*, leaving all their Moveables for want of Veſſels, and arrived at *Amboyna* this 18th of *July*, 1693.

Several burning Mountains have now been filled up and quenched; others have begun to open themſelves, and caſt out Fire, as in the Iſle *Chiaus*.

There is likewiſe a burning Mountain upon the Iſland *Celebes*: And in an infinite Number of Places there is hot Water found, if you dig but 10 Foot deep.

In the Mountains of *Ternata* is always heard a terrible Noiſe, as of the crying of a great many People, cauſed by the Fires. It often caſteth out Stones, and is probably exceeding deep; and the rather, becauſe it is likely that the ſeveral burning Mountains of the *Molucca* Iſlands are beneath conſumed by the ſame Fire, which joineth the ſpacious Openings together.

The Burning Mountain upon *Banda* caſteth forth a prodigious Quantity of Smoak and Aſhes, oftentimes much Fire; and makes a Noiſe as if a great many of the greateſt Cannon were heard all at once. This Mountain hath caſt out ſo many Stones (and ſome near ſix Foot long) that the adjacent Sea, which has been forty or fifty Fathom deep, is not only fill'd up there, but they become many Fathoms higher than the Water; whereby it may be conjectur'd, how large the inward Cavities of this Mountain are.

By——— n. 216. p. 41. 2. After ſeveral vain Attempts to ſearch and examine the Conſtitution of the Opening of the Burning-Mountain, in the Iſle of *Ternata*, at laſt, having paſſed thro' great Difficulties, and mounted very dangerous Precipices, we arrived at the Top, *Octob.* 12. 1693. When I firſt approached this terrible *fire-vomiting Opening*, wherein there is an inexpreſſible Noiſe, I could ſee nothing of the inward Parts, by reaſon of the Smoak: Wherefore I went back a little, tarrying for a better Opportunity. After ſome time I found the Smoak very much diminiſh'd; and making haſte to the Mouth of it, I ſaw the Opening which is underneath the North-ſide, from whence the Cavity extended itſelf towards the South, till the Edges, on both Sides, came to terminate at the North-ſide of that which was fallen in: Wherefore we went towards the Eaſt-ſide, to look into the weſtern Cavity; but we ſaw nothing but a fiery and flaming Subſtance, and the Conveyances of it. We did not venture to go to the North-ſide, to ſee into the South Cavities; not only becauſe of the Southerly Wind, but alſo becauſe 'tis like, that the moſt ſpacious *Antra* are on the South-ſide, which cauſeth the Smoak to be driven Northerly; and becauſe we had formerly met with Pieces of burning Matter, that were caſt out towards the North-ſide. Having ſeen enough, and ſatisfy'd my Curioſity, we withdrew, and returned to *Malayen*, bringing with us ſome Pieces of Branches of the fruitful *Clove-trees* that we had paſſed by.

The Northerly-ſide of this burning Hole is at the utmoſt Height of the Mountain to the Northward, or from *Hori*. To the Weſt and Eaſtward of it there is, on each Side, a Hill higher than the *Brinks* of this *Hole*, both of them grown over with *Reed* or *Cane*, by the Inhabitants call'd *Cannacanna*: The moſt weſterly is ſituated more Northerly from the *Hole*; on the South-ſide of this we got up. The moſt Eaſterly, on the contrary part, lieth more backwards from it, and to the Southward of it. The Southerly Hill, on the Weſt-ſide of the *Mountain*, turns about to the Eaſtward, with a Riff or Ridge, and terminates at the North-ſide of the *Mountain*. The *Mouth* of this fearful *Hole*, on the Weſt and South-Eaſt Sides, is ſurrounded, as by a Bank; each Bank having a ſeveral *Ditch*, and the Brink of the *Mouth* is upon the higheſt part deſcending on the Outſide. The three Hillets neareſt to the Hole are quite barren, and nothing but Stone; but the moſt remote is covered with thick *Reeds*.

Round about the *Hole* lies ſcattered much of the Matter that hath been caſt forth; and it is perceivable, that it muſt be ſoft when it comes out, becauſe it falls flat, according to the Figure of the Place where it falls. The *Colour* of it is dark-green, not clear, but ſomewhat grey; and this Matter generally does burſt, or ſeparate itſelf as the Dung of a *Cow*. There are of this both great and ſmall Pieces, now turned into Stone, being inwardly blackiſh and ſpongeous, mixt with white Spots: And, to give you ſome further Particulars of this burning Mountain, I have obſerved, that the extreameſt or moſt ſoutherly round Bank is all covered with *Cannacanna*; and it is the higheſt alſo. The *Smoak* of which, in reſpect of *Malayen*, ſeemed to come forth out of a higher Place, now in the deſcending of the Mountain, doth notwithſtanding ſeem to come forth at the ſame Height.

There is a *barren Hill*, that ſeems to be ſituated on the North-ſide of the *Top*, a little deſcending towards *Malayen*, but it is about the ſame Height as the higheſt Top that is ſeen from *Malayen*. Furthermore, the Reaſon why the *Smoak* ſeems to come forth from a higher Place is, becauſe the *Opening* is more Southerly; and then, in regard of only *Malayen*, it ſeems that the *Smoak* comes forth more towards the midſt. Wherefore I do certainly believe, that the right *Opening* formerly has been where the round Banks now lie; that is, to the Southward: For whereas, after a good Space of violent Burning, there groweth a ſmall Bank; any Perſon that ſhould ſee the Situation, would be of my Mind. And beſides, it being 9 or 10 Years ſince the laſt Burning was perceived, there are to be ſeen round about the Opening (beſides the Barreneſs on both Sides, which is ſome Diſtance from the Opening, in deſcending towards the Weſt and North-ſides, as alſo above on the South and Eaſt-ſides) Trees all about, of an equal Thickneſs, as all grown ſince that time, and now newly burſt and burnt by the Fire.

Laſtly, My Opinion is, that, altho' the Smoak of it hath not been ſeen from below, the Fire nevertheleſs hath not diſcontinued; becauſe the *inward Noiſe* is ſo terrible, that any Perſon whoſoever hears it, will judge with me, that it is a *bottomleſs Pit* of the *vehementeſt Fire*, which cannot be quenched while the World laſts. The Horror and Danger that one undergoes, who will ſee this, is rather to be conceived by Thoughts, than expreſſed by Words.

3. *Nov.* 2. 1694. A very thick *Smoak* was ſeen about the Top of the *Mount Gownong Apy*, which was much augmented on the 21ſt and 22d, and that Night the *Flame* broke out: On the 23d, 24th, and ſome following Days, the *Fire* was continually encreaſing on the Weſt-ſide, and with ſuch Blows, as if the greateſt Pieces of Cannon had been diſcharged; ſo that we were fearing that the whole *Mountain* ſhould have been caſt upon us. A Day of *Humiliation* and *Prayer* was proclaimed by the *Government* againſt the 7th, throughout all *Banda*. Sometimes the *Mount* brought forth ſuch a *Noiſe*, as the greateſt Storms can do about the Rigging of a Ship, or a Building on Shore; and afterwards followed *Stones*, on the *Weſt-ſide*, as far as the Sea, which was a hor-

By * * * n. 228. p. 530

rible Spectacle. Fiſhermen have related to me, that ſo many Stones have been caſt out already, that the Place where they uſed to fiſh with Lines at 40 Fathom Water is now dry; and the Fire cometh out of the Water ſo vehemently, that it is dreadful to ſee; and the Water is ſo hot, that we cannot come near it: And now the Mountain burneth moſt towards the Side of the *Loutoir*. The Trees on the Eaſt and Weſt-ſide are altogether ſpoil'd, and the Weſt-ſide is covered with Stones God knoweth how high. The Stink of *Brimſtone*, during the Weſterly *Monſoon*, is ſo intolerable, that one could ſcarce endure it in the Streets of *Neira*, where it cauſeth a great Sickneſs. The Water which runneth down is, by reaſon of the *Brimſtone* and *Salt-Petre*, become ſour, and without a natural Taſte. The Gardens which were on the *Gownong Apy*, and formerly brought forth great Store of Fruits for Man's Livelihood, are partly covered with Stones, and partly Deſert. The greateſt Fear is, becauſe it is *conſum'd inwardly* towards the *old Hole*, which was blown up in the Year 1615; and becauſe the Fire ſeemeth to take its Courſe towards the South-Weſt, and that it being quite hollow there will tumble inwardly, or be ſubverted.

By - - - ib. p. 531. 4. The Mount *Gownong Apy* caſteth out Stones round about the Mountain, and the Fire aſcendeth ſo high, that we can ſee it above the High-land at *Denter*.

By - - - ib. p. 532. 5. Mount *Gownong Apy* (burning continually) doth caſt out ſo great a Quantity of Fire and Aſhes, that the *Trees* of the Country *Neira*, and part of thoſe on the high Country of *Loutoir*, are ſo much covered with Aſhes, that not one good Fruit is to be expected from them.

By - - - ib. 6. At *Neira* there is neither *Leaf* nor *Herb*. The Ground is cover'd with *Stones* and *Aſhes*; one half of the high Country is likewiſe in a ſad Condition; many *Trees* are wholly or partly *dead*, and the reſt *lingring*. There is not one Houſe at *Neira* without Damage; ſeveral are quite demoliſhed to the Ground by the Weight of the *Duſt* and *Aſhes*.

Thoſe of *Denter*, *Weyer*, *Celam*, and the inward Coaſt, as far as *Walking*, have likewiſe a ſad Experience of this Calamity. We are ſometimes viſited with *Earthquakes*; and eſpecially *May* 11th, 1695, about 2 o'Clock in the Afternoon, we had two hard *Motions*.

By M. Nich. Witzen, n. 228. p. 529. 7. The Mountain *Kemas*, or Brothers, in the Territory of *Manado*, is blown up with a moſt *dreadful Noiſe*, as of the hardeſt Thunder, which cauſed *Darkneſs* and an *Earthquake*, with very heavy Blows, and other diſmal Signs at *Ternata*: Which Noiſe hath alſo been heard at *Amboyna*. The Mountain of *Brimſtone* upon *Amboyna*, call'd *Wawany*, does alſo *burn dreadfully*.

From all which it ſeemeth evident, that in thoſe Parts and Seas there are *ſubterraneous Fires*, having a mutual *Communication* one with another; which God knoweth but may, at ſome time, cauſe the ſudden *Subverſion* of them, and conſequently a notable Change or Alteration of the World's Globe. Thoſe who have ſeen theſe things with their own Eyes, have told me, that when a Hole is made in the Ground 10 or 12 Foot deep, the Ground is *warm*.

An Earthquake *near* Oxford, 1665; *By Dr.* Wallis. n. 10. p. 166.

XIV. 1. On the 19th of *Jan.* $166\frac{5}{6}$ at divers Places near *Oxford* was obſerved a ſmall *Earthquake* towards Evening. In *Oxford* itſelf I do not hear that it was obſerved to be an *Earthquake*; yet I remember, about that time (whether preciſely then or not, I cannot ſay) I took notice of ſome kind of odd Shaking or Heaveing, I obſerved in my Study, but did impute it to the going of Carts, or Coaches, ſuppoſed to be not far off; though yet I did take notice of it, as a little differing from what is uſual on ſuch Occaſions, and wondered the more that I did not hear any: But, not knowing what elſe to refer it to, I thought no more of it. And the like Account I have had from ſome others in *Oxford*, who yet did not think of an *Earthquake*, it being a rare thing with us.

I find my Notes, concerning my *Thermoſcope* and *Baroſcope* for that Day to be theſe.

$166\frac{5}{6}$. *January.* Day.	*Hour.*	*Thermo.* *Inches.*	*Baroſc.* *Inches.*	*Weather.*
19.	8. *Morn.*	$14\frac{1}{16}$	$29\frac{1}{4}$	Hard Froſt. Cloſe.
	4. *Even.*	$14\frac{1}{8}$	$29\frac{1}{4}$	Hard Froſt. Cloudy.
	9. *Even.*	$14\frac{1}{4}$	$29\frac{1}{4}$	Rain. Wind.
20.	8. *Morn.*	$15\frac{1}{4}$	$28\frac{1}{4}$	Sunſhine. Wind.

I hear, it was obſerved at *Blechington*, about 5 Miles to the North of *Oxford*, and ſo along by *Boſtol*, *Horton*, *Stanton*, St. *John's*, and ſo towards *Whately*, which is about 4 Miles Eaſtward from *Oxford:* Not at all theſe Places at the ſame time, but moving forwards from *Blechington* towards *Whately:* For it was at *Stanton* about 6 of the Clock, or later (as I underſtood from Mr. *Boyle*, who was there at that time) but had been at *Blechington* a good while ſooner. And I am told, that it was taken notice of by Dr. *Holder* (a Member of our Society) who was then at *Blechington*, to be obſerved by thoſe in the farther Part of the Garden, ſome very diſcernable time before it was obſerved by thoſe in the Houſe; creeping forward from the one Place to the other.

By Mr. Rob. Boyle, n. 11. p. 179.

2. Riding ſomewhat late betwixt *Oxford* and a Lodging I have at a Place 4 Miles diſtant from it, I found the Cold very piercing, which put me upon galloping at no very lazy rate; and yet, before I could get to my Lodgings, I found the Wind turned, and felt the Rain falling. This Accident, conſidering the ſhortneſs of the time, and that it was preceded by a ſettled *Froſt*, was ſurprizing to me; being one of the greateſt and ſuddeneſt Alterations of the Air, I had ever obſerved. Soon after (by my Gueſs about an Hour) there was a manifeſt Trembling in the Houſe where I was, which ſtands high in Compariſon of *Oxford:* But it was not there ſo great, that I ſhould have taken any notice of it as an *Earthquake*, if I had not been advertiſed of it, as being taken notice of by the People of the Houſe. Soon after there hap-

pened a briſk Storm; whereupon I ſent to make Inquiry, at a Place called *Brill*, which ſtanding upon a much higher Ground I ſuppoſed might be more obnoxious to the Effects of the *Earthquake*. The Perſon I ſent to writ me a Ticket; whoſe Subſtance was, that the *Earthquake* there was much more conſiderable, that where I lodged; and that a Gentleman's Houſe in the Neighbourhood trembled very much, ſo as to make the Stones manifeſtly to move to and fro in the Parlour, to the great Amazement and Fright of all the Family. The Hill, whereon this *Brill* ſtands, I have obſerved to be very well ſtored with Mineral Subſtances of ſeveral kinds. I have been informed by others that this *Earthquake* reached a good many Miles.

By Dr. J. Beale, n. 116. p. 357.

3. I conceive the *ſubterraneous Steams* might be the Cauſe of ſuch a *Midland Earthquake*. And I know no ſurer or better Way to find out the Nature and Properties of thoſe Steams, than by obſerving the Effects, and all the Alterations of the Air, as Mr. *Boyle* and Dr. *Wallis* have done.

An Earthquake *at* Oxford, 1683; *by Mr.* Tho. Pigott, n. 151. p. 311.

XV. *Sept.* 17, 1683. An *Earthquake* happen'd here at *Oxford*. The Rarity of ſuch Effects make many People not know what they are; and, by heightning their Surprize, impoſes upon their Judgments. One fancied it to be the falling of ſomething about his Houſe; another the tumbling of Wood; a third the rattling of a Cart; one, one thing, and one another; till either a mature Deliberation, or Intelligence from other Hands, convinced them to the contrary, and ſatisfy'd them it was an *Earthquake:* Beſides, the ſhort Continuance of the Trembling would hardly permit them to make any accurate Obſervation.

I, for my part, perceived the *Sound* and *Motion* very plainly; and though, when I ſaw the Clearneſs of the Morning, I judged that to be an *Earthquake*, which otherwiſe I might have thought to have been only a diſtant Thunder, yet had I not ſo clear an Impreſſion of it in my Mind, as to make any conſiderable Obſervations of my own: So that what I can afford you will be only ſome Occaſional Reflections upon *Earthquakes* in general, and Remarks upon the Intelligence which I have picked up here and there, concerning this in particular.

1. This *Earthquake* happened at a time, in which ſuch Effects are commonly experienc'd, if we may credit *Ariſtotle*, who tells us, That they are moſt frequently, tho' not always, in *Spring* and *Autumn*; in which there is generally a greater Abundance of *Moiſture* ſuck'd up, more *Vapours*, and a larger Quantity of *Nitre* (as Experience doth demonſtrate;) all which Ingredients may conſpire to the producing of an *Earthquake:* For if we conſider how capable they are of a large *Expanſion*, how forcible they are when rarefy'd in Veſſels, cloſed and placed over the Fire; in *Æolipyles*, from which they break out with forcible Blaſts, or in Winds, which frequently proceed from the *Rarefaction* of ſuch Principles; we may ſuppoſe that thoſe *Vapours* which produce ſuch great Commotions in the Air, may cauſe a conſiderable Diſturbance in the *Earth*, when pent and locked up by Cold, or any ſuch like Accident.

2. The latter part of the firſt Week in *September* was ſo rainy, that moſt People were apprehenſive of a Flood; and upon *Sunday*, the 9th of *September*, there fell ſome very conſiderable Showers in the Afternoon; but from that time it cleared up, and to the End of the next Week continued very warm and pleaſant Weather. The Evening of *Sunday* the 16th was inclinable to Froſt, and the next Morning it was found to be a very hard Froſt, for the Seaſon; and then about Seven of the Clock, the Day being very Clear and Calm, the *Earthquake* happen'd. The like Obſervations of Cold preceding that of $166\frac{5}{6}$ were made by Dr. *Wallis* and Mr. *Boyle*.

3. The Quick-ſilver in the *Barometer* (as I am told by the Operator in *Chymiſtry* here) ſtood as high then as at any time theſe three Years; which, together with a remarkable Calmneſs of the Air, a matter generally looked upon as one of the Circumſtances which accompany *Earthquakes*, and by many reckoned among the Signs which fore-run them, may be ſufficient to ſhew how free the Air was from Vapours at that time; and ſurely, the fewer there were above, the more may be ſuppoſed below.

4. *Ignes Fatui* were frequently ſeen a few Days before this *Earthquake* happen'd; which may paſs for a probable Argument, at leaſt to ſhew how full the *Earth* was then of *Damps* and *Exhalations*; ſince a *Stench*, that hath tainted Well-water after an unuſual manner, hath upon the ſame Account been generally reckon'd amongſt the Signs of an *Earthquake*, by which it may be predicted: For by this it was that *Pherecydes* is ſaid to have preſaged the *Earthquake* of *Lacedæmon*; and *Helmont* mentions another, who pretended to the ſame Fore-ſight by taſting the Water of a very deep Well in the Caſtle of *Lovain*.

5. The Motion of this *Earthquake* was not of that Sort, which are termed *Pulſes* or *Succeſſions*; ſuch as ſtrike the Ground at right Angles with a violent Shock, or intermittent Knocking, ſo as oftentimes to raiſe the *Earth* to a conſiderable Height, or force their Way by a Breach. But it appear'd rather to be ſuch a trembling Motion as vibrates and ſhakes without altering the Poſition of the *Earth*, and leaves all things in the ſame Poſture in which it found them. For it ſhook the *Earth* with a *tremulous* and *vibrating Motion*, whoſe Reciprocations were repeated with a great deal of Quickneſs. The *Pulſes* were, as I could perceive, a little diſcontinued, and yet they came ſo thick that I could not count them, tho' the whole *Earthquake* continued here ſcarce more than 6 *Seconds* of Time; and, when that ended, the *Motus Reſtitutionis*, or Settling of the Building in which I was did ſeem to be with a Craſh.

6. Now as *tremulous* and *vibrating Motions* are proper to produce Sounds, ſo was this *Earthquake* accompanied with a *hollow murmuring* Sound, like diſtant Thunder, as I have obſerved before; which Sound kept time ſo exactly with the Motion, and was ſo conformable to it in all reſpects, that it plainly appears there was the ſame Reaſon for both. To thoſe that were within doors it appeared to be more conſiderable, and as it were in the Air above, occaſioned chiefly by the Shaking of the Building; as we may gueſs by a Blow or Stamp in a Room, which, beſides the principal Sound from

the part which is ſtricken, cauſes another obſcure one, together with a ſmall Shaking throughout the whole; and in the *Laboratory* it was heard more loud: For all Sounds have a great Advantage there. But thoſe, who were abroad in the Fields and open Air, perceived with a gentle Shaking a hollow Murmur towards the Surface of the *Earth*, not unfitly compared to the Groaning of ſome Planks of Elm, Aſh, or Firr, when the Application of Fire cauſes both a Trembling and Sound. That there is a conſiderable Heat within the *Earth* is manifeſt from the Experience of Mines working in the deeper Grooves; from thoſe hot Springs which break out thence from Fermentations occaſioned by Mineral Spirits. Nor is it leſs commonly obſerved, that ſuch *Heats* and *Fermentations* within the *Earth* are augmented by Froſty *Weather*; when the Steams being more pent up, and hindred from breaking out, do work more forcibly upon one another. And that Sounds and Tremblings may be produced by ſuch *Heat*, though it did but work upon *Air*, *Watery Vapours*, or *Nitre*, only included in Pores and Cavities, appears by ſeveral Experiments; as that of filling Glaſs-bubbles half full with *Water* and *Nitre*, which being ſet to the *Heat* of the Fire will tremble with a ſort of humming Sound, and after that break with a great deal of Noiſe and Violence.

7. This Sound as well as Trembling appears to have been the ſame in moſt of thoſe places where they were perceived; from whence we may infer, that they were not cauſed by the falling of the *Earth* or *Rock* from the upper part of ſome Cavern; nor from any Commotion of Vapours within the Hollows, as Powder works in a Mine, by which Similitudes it is uſual to expound ſome *Earthquakes*: For then it would have been perceived more plainly in places above it, or thoſe that were near adjoining, and not equally conſiderable in Towns of ſuch various diſtances, as *Oxford*, *Burford*, *Watlington*, *Benſon*, *Brill* and *Ailsbury* in *Bucks*; *Wallingford*, *Radley*, *Appleton*, and ſome other Places in *Berkſhire*; with many more round about.

8. Yet I cannot but ſay that it was leſs conſiderable in ſome places than in others; the Men of ſome *Towns* ſpeak dubiouſly, eſpecially towards the North of *Oxford*; and ſome talk of a neighbouring *Town* feeling it, tho' their own did not. Yea, even here in *Town*, the *Earthquake* was not perceived ſo plainly in ſome places as in others; but that may depend upon Circumſtances, as the Poſition and Form of the Houſes; or ſome Accidents, as Noiſe and Carts intervening, which might render it leſs obſervable. Beſides, I do not deny but there may be ſome *Cuniculi*, little Paſſages or Hollows here and there under Ground, which might advantage the Trembling; and elſewhere more ſolid Parts, which might damp and obſtruct it.

9. This might occaſion ſome Difference in the Sound too. One perceived it like a Voice under Ground, but he could not tell which Way it paſſed; perhaps there might be a Cavern there. Another who was travelling over *Shotover* heard the ſame; and it is very likely that there are conſiderable Hollows there. One who was fiſhing in the *Charwel* informs me, that whilſt his Boat trembled under him, and the leſſer Fiſhes ſeemed much affrighted,

frighted, by an unuſual skipping, he heard the Murmur, as of a riſing Wind, which he fancied juſt then breaking out, and rumbling upwards, but felt none. The like Relation, as to rumbling in the Air, I have from good Hands, concerning ſome People that were in *Dourton-Park* in *Buckinghamſhire*; which I mention only for the Diſtance ſake; for moſt hereabouts agree in the ſame Fancy. I myſelf heard it like a diſtant Thunder; a Noiſe determined to one Place, not fleeting or paſſing from me; though the Craſh, which ended the ſhaking of the Building, little deceived me in my firſt Imaginations.

Ariſtotle (*de Mundo*) calls the *Earthquakes* of this kind by the Name of Βράσται, as if they boiled, becauſe they ply up and down. And I take this that happened here to be no ſuch forcible or irregular Ebullition, raiſing the *Earth* with intermitting Shocks, as that of *Mechlin* for inſtance, *Apr.* 4. 1640, deſcribed by *Van Helmont*; but a regular *Efferveſcence* of incloſed Vapours, more evenly diſperſed, working up and down the *Earth*, with a trembling of each Part, and a reciprocal Agitation of the whole. For I could never meet with any, who pretended to determine from what this *Earthquake* came, or whither it went.

10. All, who felt this *Earthquake*, ſay, it happened about 7 a-clock; but I dare make no inference from hence, that the Shaking really was in all Places at the ſame time, unleſs the time had been exactly obſerved to a Minute, at leaſt in ſeveral Places. For ſince all *Tremors* and *Sounds* are found to move about 15 Miles in a Minute, and above 94 in an Hour; and conſequently the Trembling of the *Earth*, paſſing along with a continued *Noiſe*, may be ſuppoſed as quick in its Motion; it might, according to this *Calculation*, in a Minute's time have reach'd the Extremity of its Sphere or Compaſs: For the Circuit of this *Earthquake* was but 70 Miles, or thereabouts; its largeſt Extent was from South-Eaſt to North-Weſt; the leaſt, from *N.* to *S.* For it was perceived a little ſhort of *Kirlington N.* of *Oxford*; at *Blechington*, and at *Ailsbury S. E.* where it was perceived plainly; as alſo at *Thame*, which is *E.* and ſo at *Aſton*, *Kingſton*, and *Stoken-Church-Hill*; at *Watlington S. E.* (ſome ſay at *Reading*, which is more *S.* and then its Compaſs may be ſuppoſed larger;) at *Wallingford S. E. by S.* as much as any place; at *Abingdon S.* but not much; not ſo far as *Farington S. W.* but at *Bampton W.* at *Burford* to the North; at *Lo. Harborough N. W.* not much; at *Woodſtock*, which is more *N.* little or none; and at *Glympton*, 2 Miles beyond it, not at all, as I am informed. But this is a very inconſiderable Space, if compared with that which happened in the Southern Parts of *Norway*, *Apr.* 24. 1657. and took up 160 Miles in length, and ſo much in breadth, ſaith *Michael Peterſon Eſcholt*, that deſcribes it; and *Kircher* mentions one 200 Miles in length.

11. The Effects too of this *Earthquake* were very inconſiderable; as ſhaking down ſome *Pewter*, in a very few Places; caſting out a Truckle-Bed *Weſtward*; which, when I looked upon, I found ſo very eaſy to move, and apt to run, as alſo the Room ſo ſmooth, and declining towards that Point, that I could as little infer from thence that the Motion came this or that Way, as from the falling of many Books from the North-ſide of a Warehouſe,

houſe, when a few only fell from the South. And of whatever Nature the encloſed Vapours were, which cauſed this *Earthquake*, it ſeems as if they were not able to force their Paſſage through the *Earth* (at leaſt but ſlowly:) For the Air, till the End of the Week, continued fair; tho' Week enſuing was very windy and boiſterous.

12. We have *Earthquakes* here very ſeldom; not one before for almoſt a Score of Years, except that which is doubtfully reported to have happened about four o'Clock in the ſame Morning. But ſeeing the *Earth* abounds with ſuch great Variety of Matter, which may produce them, as alſo with ſo many Caverns and Chinks of ſuch various Figures through which they may be agitated with ſuch different Motions, it ſeems more eaſy to ſhew how they may begin, how they may be carried on, how they may produce ſuch different Effects, and how they may continue; than to determine why they ſhould happen ſo rarely, do no more miſchief, or be ſtopped ſo ſoon in their Motion.

An Earthquake in the Midland Counties, 1683. *By Mr* Tho. Pigott, n. 151. p. 321

XVI. There was another *Earthquake* far more conſiderable, which happened *Oct.* 9. about 11 at Night, and was in *Oxfordſhire*, Northwards, very much; ſome ſay, they felt it here at *Oxford.* It ſpread all over the *Midland Counties*, and extended into *Derbyſhire*; in which, as in the Coal-Countries, it was very violent. They report, that it was in all its ſeveral Places at the ſame time, not determining preciſely, and that it produced ſome remarkable Effects.

*An Earthquake in Si*cily, 1692-3 *By Mr.* Martin Hartop. n. 202. p. 827

XVII. 1. It ſeems highly probable, that theſe Tremblings of the *Earth* proceed from the ſame incens'd Matter, which finding a way at other times thro' the *Mongibello* has ſo furiouſly broken out in Smoak and Fire. This appears by the Tragedy of *Catanea.*

The *Eruptions* of theſe *Mountains* are of two Sorts: The one not ſo very violent, as to diſturb much the adjacent Country; and this happens once in 2 or 3 Months, and laſts 3 or 4 Days: The other is more furious, and of longer continuance; and is obſerved here at *Naples*, to happen to Mount *Veſuvio*, once in about 80 Years, as I heard the ingenious Mr. *Peccacio* ſay. Of theſe, the laſt in 1632 was ſo very violent, that, by the beſt of his Obſervation, it caſt the Rocks 3 Miles into the Air. Now, from the burning or not burning of this Hill, *Naples* (and without doubt the ſame holds in *Sicily*) calculates its Safety or Danger of *Earthquakes*: For without doubt the Matter is continually burning under the Mountain; and thoſe vaſt Clouds of Smoak which daily iſſue out of the Top, if the Cavity happen by any Rock or inward Alteration to be ſtopt, muſt deviate through other Paſſages under Ground, heaping up continually Magazines for a future Calamity. Now this combuſtible Matter ſeems to me to be nothing but *Nitre*, mixed with ſome other *Minerals* and *Sulphur*. He, that has ſeen the Way of making *Salt* of *Tartar* by *Deflagration*, where you mix an equal Quantity of pulverized *Nitre*, has ſeen an exact Type of theſe burning Hills; for, after each Spoonful you put into the burning Crucible, ariſes firſt a black thick

Smoak, after which the fired Mineral boils up, as if it would over-run the Top of the Crucible.

The Motion of the *Earth* is not from the *Perpendicular*, or *Horizontal*; as appears by the Cracks in the *Earth*, which, they ſay, are to be found now all over *Sicily*: 'Tis a Vibration ſo quick, that it cracks the Glaſs in the Windows; 'tis diſputable, whether the *Reciprocations* of a Lute-String are more frequent. Now, when the *Vibrations* are ſo quick, and the Body moved ſo great, the Motion muſt be prodigiouſly violent. We obſerve that Thunder, which is the Effect of the Trembling of the Air, cauſed by the ſame Vapours diſperſed thro' it encountring one the other, has force enough to ſhake our Houſes. And why there mayn't be Lightning and Thunder under Ground, in ſome vaſt Repoſitories there, I ſee no Reaſon; eſpecially if we reflect, that the Matter, which compoſes the noiſy Vapour above us, is in much larger Quantities to be found under Ground. I can attribute this *Horizontal Trembling* to nothing elſe, but the furious Paſſage of the incens'd Matter from one Grotto to another: For 'tis very probable theſe are continued, in ſome Parts of the *Earth*, for ſeveral Leagues together; witneſs your laſt *Earthquake*, about 4 or 5 Years ago; which was felt (with little Difference as to Time) in *England* and *Ireland*. Another Confirmation of this is, the Manner how theſe trembling Fits are performed; which is not all of a ſudden, like that of *Gun-powder* in a *Mine*; but is ſmall at firſt, afterwards gradually more terrible, like a growing *Tempeſt*. A third may be, the Obſervation of ſome here in *Naples*; that, when Mount *Veſuvio* ceaſes to burn, the *Sulfaterra* ſends out its Fumes more violently; & *vice verſa*. Now this *Sulfaterra* is a Hill near *Puzzolo*, as diſtant from *Naples* on the one Hand, as the Hill *Veſuvio* is on the other; ſo that 'tis more than probable, that *Naples* ſtands upon a burning Arch, thro' which, as a Pipe, their two furious Neighbours do reciprocally receive the abovesaid *Exhalation*. This ſeems to me a growing Evil to this wealthy and populous City; and what may poſſibly make good the Prediction of *Sanazarius*, who was born here:

Et te, quis putet hæc? Altrix mea, durus Arator
Vertet: & Urbs, dicet hæc quoque clara fuit.

2. The Iſland of *Sicilia*, of 700 Miles Circuit, and divided into 3 Valleys; began on *Friday* the 19th of *January*, 1693, about half an Hour paſt 4 o'Clock, to be ſenſible of the Shake, in the Valley of *Mazara*: But, in the two other Valleys of *Emone* and *Noto*, the *Shakes* were ſo terrible, as to throw down ſome Buildings, obliging the Inhabitants to ſeek Refuge, either in the Fields, or with Prayers and Tears implore the Divine Pity in the Churches. On *Sunday* following, being the 11th of the ſame Month, at 20 Hours and 3 Quarters, the Hand of God appeared much more terrible, awakening the moſt lethargick Sinner. The *Shakes* of the *Earthquake* did no damage in the Valley of *Mazara*, only frightning of the People.

By P. Aleſſandro Burgos, *ib.* p. 830

Palermo received ſome Detriment in moſt of the Buildings, eſpecially the Palace and Hoſpital of St. *Bartholomew*; the Steeple of St. *Nicholas*, belonging to the *Auguſtines*, was ruined, and ſome hurt done to the Church; but little Miſchief elſe done, and no Body hurt.

In *Meſſina*, all the Buildings of the *Theatre* are ſhatter'd; the Royal, and Archbiſhop's *Palace*, with the Seminary, are all cracked: The vaſt and ſtately Church of the *Franciſcans* broken in many Places, and the Roof of the *Veſtry* fallen; the *Steeple* of the Church of the *Annunciation* thrown down, with the Death of the *Sexton*; the Top of the *Spire* of the *Dome* cleft: Many private Buildings were thrown down, and all the reſt ſhored up; there were but few Perſons killed.

Troina, *Randazzo*, *Nicoſia*, Cities in the Mountains, ſuffered in their Buildings. The firſt, and half of the Mother-Church were deſtroyed, with the Pariſh-Church of St. *Lucy*, and was much damaged in its Monaſteries; one whereof is not habitable: The laſt had its *Dome* very much hurt. *Caſtigleone* had the Caſtle and many Houſes thrown down. In *Franca Villa* and *Linguagroſſa*, the greater Part of the Buildings, and ſome Churches. *Maſcalli* quite ruined, but not many killed; moſt of the People being abroad, at a Proceſſion with the Reliques of St. *Leonard* their Protector.

Aidone received a conſiderable Miſchief; two whole Quarters, with many of its Inhabitants, being deſtroyed; in the Quarter of St. *Laurence* there is not one Houſe ſtanding, and the Churches ruined; in that of St *James*, the Church of the *Annunciation* and its *Oratory* thrown down, with ſeveral other ſacred Edifices. In the other Part of the City, which ſtands lower, there were not ſo many Houſes nor Perſons loſt; yet the Church of Pope *Leo* is quite flat, and the magnificent Church of the *Dominicans* in Ruins, with the Convent of the *Reformati Oſſervanti*, one of the beſt in the whole Province.

Abi Aquilea, commonly called *Jaci Reale*, ſituated at the Foot of *Ætna*, is almoſt quite deſtroyed, and its Inhabitants buried in the Ruins, with many Convents; amongſt the reſt, the famous one of the *Oſſervanti Reformati*.

Aci St. Antonio, *Aci St. Filippo*, *St. Gregorio*, *Pedara Trecaſtagni*, *Bonnacorei*, *Nicoloſi*, *Motta*, *Meſterbianco*, *Fenicia*, and ſeveral other fruitful Villages, ſituated near *Mongibello*, are deſtroyed, with all the Habitations of pleaſant Hills about *Catanea*, which are now in the Duſt.

Paterno, about 12 Miles from *Catanea*, a populous City, at the Foot of *Mongibello*, loſt moſt of its Buildings, all the Convents of Fryars, and a very fine Monaſtery: In the Ruins were buried 40 Perſons. *Aderno* had the ſame Fate.

Cantabiano Piemonte in the Valley of *Emona*, *Francofonte*, *Palagonia* in the Valley of *Nota*, are little leſs than wholly levell'd, and about 300 Perſons deſtroyed. The Marquiſs of *Francofonte* was miraculouſly ſaved, by leaping out through the Crack in the Wall of the falling Edifice.

Catanea, one of the moſt ancient and famous Cities of the whole Kingdom, honoured by the Courts of ſeveral Monarchs, and an Epiſcopal See even from the Times of the Apoſtles, giving place to none in the Beauty of its ſacred Edifices; amongſt which, the *Dome* was the moſt ſumptuous and large in all *Sicily*, adorned with excellent Pictures and richly furniſhed, bleſſed with the Reliques of the invincible Martyr St. *Agatha*, and honoured with the Bodies of ſeveral Kings; beſides it had a very high and curiouſly built *Steeple*. Here were a great many Nunneries; amongſt the reſt, the Monaſtery of the *Trinity*, and that of St. *Benedict*, with that Prodigy of Workmanſhip the magnificent Monaſtery of St. *Nicholas*, with its Temple; a Place famous for ſeveral Reliques. Next, the *Jeſuits* College, the Convent of the *Minorites*, and two of the *Dominicans*; the beautiful one of *Capuchins*, the Imperial Convent of the *Carmelites*, that of the *Reformed Minorites*, that of the *Reformed Auguſtines*, with ſeveral other Friaries, with an infinite Number of the antient and modern Churches, Colleges, and other publick Buildings, inhabited with 23000 Souls.

Its Nobility, many and antient: Learning was here in its Glory; the Citizens were themſelves learned, and Lovers of Knowledge, aſſiſted with the many Privileges granted by the King. The Univerſity, where the learned Laurel was conferred on the Worthy, made this Place the *Sicilian Athens*. This once ſo famous, now unhappy *Catanea*, had the greateſt Share in this Tragedy. Father *Antonio Serrovita*, who was to preach at *Catanea* the Lent following, was on his way thither on the 11th, at 20 Hours and ¼; and at the Diſtance of a few Miles he obſerved a black Cloud, like Night, hovering over the City; that there aroſe from the Mouth of *Mongibello* great Spires of *Flame*, which ſpread themſelves all round; that the Sea, all of a ſudden, began to roar, and riſe itſelf in ſwelling Billows; that there was a very great and dreadful Blow, as if all the Artillery in the World had been at once diſcharged; that the Birds flew about aſtoniſh'd in the Air; that the Beaſts and Cattle in the Fields ran crying about, affrighted; that his and his Companions Horſes were ſo ſtartled, that they ſtood ſtock ſtill, trembling ſo as that they were forced to alight; which they had no ſooner done, but they were lifted from the Ground above two *Palmes*; and caſting his Eyes towards *Catanea* he with Amazement ſaw nothing but a very thick Cloud of Duſt in the Air. This was the Scene of their Calamity. For of the magnificent *Catanea* there is not the leaſt Footſtep to be ſeen. All its Edifices are levelled with the Ground, except the Chapel of St. *Agatha*, the *Rotunda*, the Caſtle of *Urſino*, the Walls that encompaſſed it, and a few mean Houſes. There was a very great Deſtruction of the Inhabitants buried in the Ruins of the Biſhop's Palace, the Steeple, and *Dome*, where moſt of the City, frighted with *Friday*'s *Earthquake*, were got together to carry the Reliques of St. *Agatha* in Proceſſion. Many of the Nobility were ſaved under the Chapel of the Saint, and ſome of the Clergy: The Number of the Dead were about 15000; for though the People had ſtaid in the Fields all the *Saturday*, yet the Solemnity obliged them to be in the City on the *Sunday* to pay their Devotions at the Proceſſion. Of the *Benedictines*, about 25 were killed in the Quire; of the *Jeſuits*, 21; of the *Conventuals*, 11; the Number of the *Dominicans* is not known; the *Carmelites* were all buried, except one, as they went in Proceſſion; and ſo were the greater Part of the other *Religious Orders*; and of the *Nuns*, few were ſaved. This was the Tragedy of

Catanea; which was accompanied with dreadful Lightning and Thunder from Heaven, with Deluges of Rain; and in the Ruins were heard nothing but Cries, Shrieks, and dying Groans. On the Heaps of Stones we may now write, *Here was* Catanea.

Lentini, a very antient City, honoured with the Births of many illuſtrious Perſons, amongſt the reſt that Father of Eloquence *Gregorio Leontino*; of a long time an Epiſcopal See, *&c.* felt that Shock on the 9th, with ſuch Violence, as threw down and ruined the greater Part of its Buildings: amongſt which was the antient Convent of *Minorites*, famous for being the Dwelling-place of St. *Anthony* of *Padua*; the *Royal Convent*, ſo called from the Tomb of one of our Queens, buried there; under the Ruins of which four Religious were buried; the reſt eſcaped miraculouſly. But the laſt *Earthquake* on the 11th laid in the Duſt the Remainder of the City, with the Death of about 4000 People, that return'd thither after the firſt Shake to take care of their Goods: So that now there is but the Carcaſe of a City, all ſhatter'd to Pieces, not one Houſe left ſtanding.

Carlentine, a modern City, being as a Citadel dependent on *Lentini*, had the ſame Fate. The beautiful Caſtle of *Licodia* all ruined, with the Marchioneſs of *Martini* and all her Children buried therein.

Bizrini, a City of rich Inhabitants, is levelled with the Ground.

Sortino and *Caſſero* are quite demoliſhed; in the firſt about 300 periſhed.

Agoſta, a trading Town, built on an Iſland, in a large Bay which makes a capacious Port, was all blown up into the Air; for, beſides the Damage of the *Earthquake*, there was a great Quantity of Powder in the Caſtle, that took fire and killed ſeveral of the Citizens, that had eſcaped into the Fields, with the Stones of the Buildings. Here periſhed about 3000. The enraged Sea grew terrible boiſterous, and tempeſtuouſly beat againſt the Walls of the *Dominican Convent* with ſuch Fury, that ſome Galleys, belonging to the *Knights* of *Malta*, ſcarcely eſcaped Shipwreck in the Port. In fine,

Luctus ubique, Pavor, & plurima Mortis Imago.

The Country of *Milili*, in the Dutchy of *Montalto*, felt the ſame Fate, with the Deſtruction of the Inhabitants.

Syracuſa, famous in old time, an Epiſcopal See; in our Time, like the *Phenix* ariſing from the Aſhes, ſtanding upon a *Peninſula*, by Art made an Iſland, having a Bridge to the main Land; ſtrengthned with a modern Fortification, ſufficiently populous, by Reaſon of its convenient Situation for Trade; full of Nobility, and beautified with Churches, Convents, Monaſteries, and Palaces, now mourns in Ruins. It was ſenſible of *Friday*'s, but ſhook to Pieces by the *Sunday*'s *Earthquake*, with the Loſs of many thouſand Perſons. Moſt of the Nobility ſaved themſelves by a timely Flight. Of the Religious, not many periſhed. Scarce a Village in the whole Dioceſe is left; Confuſion reigns every where; and the Miſery is encreaſed by Want of Food, cauſed by the Granaries and Mills being deſtroyed.

Laferla, *Palazzuolo*, and *Buſceni* lie in Ruins, with many Inhabitants deſtroy'd.

Spacaforno, a populous Place, ſituated near the Sea, which waſhes the Foot of the Promontory *Pachino*, has loſt all its Buildings, Here they reckon about 2000 dead.

Giarratana with its Fall killed moſt of its Inhabitants: The Marquiſs himſelf, with his Wife and 3 Children, eſcaping on *Friday*, were on *Sunday* buried in the Ruins; the Marquiſs and his Children were taken out alive, to bewail the Loſs of his Lady.

Melitello, in the Valley of *Noto*, is ſhaken to Pieces; the Churches and chief Buildings even with the Ground, and the Religious Orders all turned out into the open Air, or under Huts and Cabbins.

Occhiula eſcaped not the common Calamity.

Mineo, an ancient City, is now no more; and the greater Part of the Citizens and Religious.

Caltagirone, a City conſpicuous for its Senate and Nobility, ſuffer'd in this univerſal Calamity the total Ruin of its proud Edifices. As the principal Church, with its very high Steeple, or Spire; the famous College of St. *Julian*; the Temple of St. *George*; the Pariſh-Church of St. *James*; admired for the Pictures of *Epiphanius*, the Chapel only remaining, with the Image and Reliques of the Saint. The Temples of the *Conventuals* thrown down; the famous Bridge that joins the Convent to the Town ſhatter'd to Pieces, and the Dormitories not to be inhabited; the famous Convent of St. *Bonaventure*, the Fall of whoſe Temple and Spire, was the Deſtruction of the lower Buildings; the College of the *Jeſuits* and the Steeple of that noble Church are quite ruined. The *Carmelites*, *Dominicans*, *Auguſtines*, *Crouched-Fryars*, &c. are all without Churches and Convents. The Monaſteries of St. *Gregory*, St. *Chiara*, St. *Salvator*, and St. *Stephen*, with a *Conſervatory* of *Orphans*, are all ſhook down. In fine, the Senate-Houſe, adorned with moſt curious Statues, and all the other Buildings, are either fallen, or threaten a ſueden Ruin. In theſe Deſolations about 1000 People were loſt.

Modica, a populous Place, and a Chief of the Seigniory of the *Admiral* of *Caſtile*, has its Buildings and famous Caſtle laid in the Duſt. Seignior Abbot *Frederick*, the *Procurator-General*, ſaved himſelf in the College of the *Jeſuits*, from whom we had the Account; and that the Cities of *Raguſa*, *Sicily*, and *Chiaramonte* had the ſame Misfortune.

Comiſo ſuffer'd much in its Buildings, tho' but few were kill'd: The Convent is down, but the Church ſtands.

Noto, an ancient and ingenious City, full of Nobility and fine Buildings, Convents and Monaſteries, as we hear from a Courier from thence, is all ruined: The Convents of the *Dominicans*, *Conventuals*, *Reformati*, *Carmelites*, and *Capuchins* which was indeed a wondrous Fabrick, are all torn to Pieces. The Church of the *Crucifixion*, the *Dome*, and all the Nunneries are down, with the Deaths of many Citizens and Nobles.

To conclude, there is not a Corner in all the Valley of *Noto*, that is not ruined wholly, or for the moſt Part, with a dreadful Slaughter of the

People. The Southern Coaſts, as *Licati*, *Terra Nova*, and *Girenti*, have ſuffered Damage in their Buildings: And all the Caſtles of the Valley of *Emone*, near *Mongibello*, are crack'd and broken, or thrown down.

By the Noble Vincentius Bonajutus. n. 207. p. 2.

In Dec. 1. l. 1. Cap. 4. *and* Dec. ult. l. 10

3. The continual fiery Eruptions of *Ætna* (of which the firſt that we have any Account of, happened 500 Years before the Deſtruction of *Troy*, as *Diodorus Siculus* relates) have been taken for the moſt likely Cauſes of the horrible Shakes that from time to time have laid waſte the Iſland of *Sicilia*; as is obſerved by *Fazello*, where he remembers That of the Year 1542, which on the 10th of *December*, at the 23d Hour, ſhook the whole Iſland; and eſpecially *Val di Noto*, *Syracuſa*, *Lentini*, *Sortini*, *Mililli*, *Catanea*, *Agoſta*, *Noto*, *Caltagirone*, *Melitello*; and in ſhort the ſame Cities and Caſtles, which were miſerably ruined by the two late violent *Earthquakes* of this preſent Year 1693.

The firſt of which was at 5 o'Clock, the next Night after the 9th of *January*: Its Motion was of that Sort which *Ariſtotle* and *Pliny* call the firſt Species, and is by them likened to the ſhaking Fit of an Ague, cauſing ſuch a Motion as ſhakes the *Earth* from Side to Side. In this firſt almoſt all the Edifices in the Country were thrown down; whereof ſome were very high and ſtrong-built Towers. A great Part of the City of *Catanea*, with many others, were demoliſhed, and a great many Buildings in *Val di Noto*; *Syracuſa* was alſo much ſhatter'd, but not ruined. This was not preceded by any Darkneſs in the Air, but a pleaſing, ſerene, warm time; which was the more obſervable, as being unuſual at that time of the Year: Yet it was not to any Exceſs.

Some Perſons, which the Evening before were travelling in the Country, obſerved a great Flame or Light at about an *Italian* Mile's Diſtance; and ſo bright, that they took it for a real Fire made by ſome of the Country People; and though they went directly towards it, yet it ſeem'd to keep at the ſame Diſtance from them. Whilſt they were obſerving this Appearance, the *Earthquake* began, which was ſenſible even to the Horſes they rode upon, that were affrighted thereat, and the Trees were all ſhaken. Upon this the amazed Travellers, looking for the Light the ſaw juſt before, found it quite vaniſhed. We perceiv'd, turning toward the Sea, that the Waves, which before the Shake only beat gently upon the Shore, began now to make a dreadful Noiſe. The next Day, which was the 10th, the Night and Day following, the Air was over-ſhadowed with Darkneſs, and tinged with a deep Yellow; and the obſcured *Sun* ſtruck our Minds with a melancholy Preſage of the approaching *Earthquake*, which was the ſecond, and happen'd on the 11th of the ſame *January*, about the 21ſt Hour, and laſted about 4 Minutes. It was much like the 2d *Sort*, which *Ariſtotle* and *Pliny* call a *Pulſe* or *Stroke*, for its reſemblance to the beating of an Artery; and by *Poſſidonius*, in *Seneca*, is repreſented by the Name of *Vibrations*, it being a perpendicular lifting up of the *Earth*. Its *Impulſe* was ſo vehement and powerful, that not only many Cities and Countries of the Kingdom of *Naples*, but the Iſland of *Malta* participated alſo of its Fury. It was in this Country impoſſible to keep upon our Legs, or in one Place, on the dancing *Earth*; nay, thoſe, that lay along on the Ground, were toſſed from Side to Side, as if on a rolling Billow.

In open Places the *Sea* ſunk down conſiderably; and in the ſame Proportion in the Ports and incloſed Bays; and the Water bubbled up all along the Shore.

The *Earth* opened in ſeveral Places in very long Clefts; ſome an Hand's Breadth, others half a Palm, others like great Gulphs. From theſe Openings that were in the Valleys ſuch a Quantity of Water ſprung forth, as overflowed a great Space of Ground; which to thoſe that were near it, had a ſenſible *ſulphureous Smell*, though in a low Degree, and without that unpleaſant Stifling produced by the Smoak of *Brimſtone.*

In the Plain of *Catanea*, an open Place, it is reported, that from one of theſe Clefts, narrow, but very long, and about 4 Miles off the *Sea*, the Water was thrown forth altogether, as *ſalt* as that of the *Sea.*

In the City of *Noto* is a Street of half a Mile long, built of Stone, which at preſent is ſettled into the Ground, and quite hanging on one Side, like a Wall that inclines; and in another Street, before the *Aſſent del Durbo*, is an Opening big enough to ſwallow a Man and Horſe.

Great Rocks were looſened, and thrown down from the Mountains every where: And in the Country of *Sotino*, inhabited by about 5000 Perſons, a great Number periſhed in the Houſes which were beaten down by them in their way, as they rolled down from the Hills. A great Ciſtern, or Reſervatory of Water, hollowed on the Top of a Rock, was looſened and thrown off from the reſt of the Rocks, and ſlid down to the Bed of the River that runs in the Bottom; where the Ciſtern remains as it was, full of the ſame Water it had received before the *Earthquake.*

A very great many *Grotto's*, made by Art or Nature, are now fallen in.

In *Syracuſa*, and other Places near the *Sea*, the Waters in many *Wells*, which at firſt were *ſalt*, are become *freſh*, and have not as yet loſt their Goodneſs; ſo they are ſtill fit to drink.

The Fountain *Arethuſa*, for the Space of ſome Months, was ſo brackiſh, that the *Syracuſans* could make no uſe of it; and now, that it is grown ſweeter, its Spring is increaſed to near double.

In the City of *Termini*, all the running Waters are dried up; and, amongſt the reſt, a ſmall River near to it, with which they watered their Gardens and Orchards. It was contrary to the *Hot-Baths*, which are augmented by a 3d Part of what they were before the *Earthquake.*

In many plain and level Places, very high Walls leaped from their Foundations above two Paces, leaving that whole Space perfectly clear and free from Rubbiſh and Ruins, as if they had been taken up, and carried off. And in *Syracuſe*, two Side-Walls of a ſmall Houſe jumped up from each other; the one upright, and ſtood upon its Bottom, at a great Diſtance from its former Place; and the other, leaving its Companion, flew away ſo as to make an Angle with the other, to the Wonder of the Beholders of ſo extravagant an Accident. Not far from the Country of *Caſſaro*, from the Tops of 2 Mountains, between which through a long Valley ran a River, two very great Rocks were looſened; which, tumbling down over againſt each other, met ſo exactly as to cloſe up the Valley, and ſtop the Current of the River; which, not finding any *Subterraneous* or Side-Paſſage, has fill'd up the Valley to the Top of the Rocks that were thrown down, and runs over them, forming a Lake 3 Miles round of a conſiderable Depth.

In the Teritory of *Sortini*, in a Piece of Ground half a Mile long but much narrow, the Ground, at ſeveral little Interſtices, is ſunk from the Level in ſome Places 2, in other 3 *Palms*, and ends in a very deep circular Gulf or Swallow.

A Fountain, in the very Minute of the *Earthquake*, on the 11th, threw forth its Waters tinged of a Blood-red; which continued for 3 Hours, and then it dried up, leaving many Holes in the Mud at the Bottom, through which real Aſhes were thrown out; and the next Day the Waters returned of the former Quality, without the leaſt Alteration.

In the City, encompaſſed with Caves on three Sides, altho' by the conſiderable Shakes that were given it there was not much Ruin made, yet a very dreadful Sound and Noiſe was heard for a great while.

The South Winds have blown very much, which ſtill have been impetuous in the moſt ſenſible *Earthquakes*, and the like has happened at other times.

From the 11th of *Jan.* to this 14th of *Sept.* there have been conſiderable and ſtrong South Winds, preceded by a Noiſe like Cannon at a great Diſtance; ſome of a longer, ſome of a ſhorter Continuance: This has been obſerved in all Parts, but louder in cavernous Places, and in the Valleys between the Mountains; where the Shakes were more violent, in Proportion to the Diſtance from the Sea.

Darkneſs and Obſcurity in the Air has always been over us, but ſtill inferior to that on the 10th and 11th of *Jan.* and often theſe Clouds have been thin and light, and of a great Extent; ſuch as Authors call *Raræ Nubiculæ*. The Sun often, and the Moon always obſcured, at the Riſing and Setting; and the Horizon all Day long duſty; ſo that our wonted Proſpects are ſhorten'd; but for ſome little time paſt it has grown ſomething clearer.

The Heat, at the Beginning of Summer, was not extreme; but, the Sun entering *Virgo*, it grew very great, and at Noons intolerable.

Since the firſt of *Auguſt*, which was a moſt tempeſtuous Day, not only for the exceſſive Rains for about 4 Hours, but for the Hail and very loud Thunder, the Shakes of the *Earthquake* have been leſs ſenſible, and ſeldomer; and for two Months not ſo univerſal; but ſometimes in one Place, ſometimes in another.

It has been obſerved, that in leſs ſolid Ground, ſuch as Chalk, Sand, or looſe Earth, the Miſchief was without Compariſon greater than in the rocky Places: And in *Syracuſa* the Difference was viſible in 3 Places; that is, in the middle of the City, in the little Iſland, and in *Zaracati*, where the antient *Syracuſa* ſtood; in all which Places the Buildings, being on a rocky Foundation, remain for the moſt part untouch'd, or only ſhaken, or at leaſt not quite demoliſhed: Whereas, on the contrary, in the reſt of that Territory, which is not rocky, a very great Number of noble Structures and Towers lie like a horrid Deſert, and Heap of vaſt Ruins.

The Effects it has had on human Bodies, altho' I do not believe they have all been immediately cauſed by the *Earthquake*, have yet been various; ſuch as *Fooliſhneſs*, but not to any great Degree; *Madneſs*, *Dulneſs*, *Sottiſhneſs*, and *Stolidity* every where; *Hypochondriack*, *Melancholick*, and *Cholerick* Diſtempers: Every Day *Fevers* have been common, with many Continual and *Tertian*; *Malignant*, *Mortal*, and *Dangerous* ones, in a great Number, with *Deliria* and *Lethargies*. Where there has been any Infection cauſed by the *natural Malignity* of the *Air* infinite *Mortality* has followed. The *Small-Pox* has made great Deſtruction among young Children; and in ſhort there has been no State nor Condition, which has not had its Share in ſo univerſal a Calamity.

The Number of the Inhabitants before the Earthquake, and of thoſe that periſhed therein

The Names of the Cities.	*Numb. of* Inhab.	*Numb. of thoſe kill'd.*	*The Names of the* Cities.	*Numb. of* Inhab.	*Numb. of thoſe kill'd.*
Agoſta.	6173	2300	*Mazzarino.*	7696	
S. Agatha.	1402	20	*Nicoloſi.*	844	4
Avola.	6225	800	*Nixerni.*	1483	
Buſcema.	2192	900	*Noto.*	12043	3000
Bonaccurſo.	844	94	*Occhiella.*	2910	100
Bontello.	172	2	*S. Giovanni Lapunta.*	1082	15
Butera.	3492		*Jaci Reale.*	12895	739
Buccheri.	3295	300	*Jaci S. Antonio.*	6363	1335
Caltagirone.	12339	800	*Leontini.*	10063	1212
Catanea.	18914	18000	*Licodia.*	4898	741
Comiſo.	5305	269	*Mineo.*		1355
Caſtel di Jaci.	331	32	*Palagonia.*	1862	29
Carleontini.	2751	77	*Pedara.*	1582	475
Caſſaro.	1458	15	*Palazzolo.*	5571	700
Chiaramonte.	4830	303	*Raguſa.*	9946	5000
Floridia.	1037	20	*Sortino.*	6316	2500
Ferla.	3610	800	*Syracuſa.*	15399	4000
Fenicia Moncada.	1651	14	*Scichili.*	9382	2000
Francofonte.	2039	345	*Scordia.*	907	33
Giarlatana.	2981	541	*Spaccafurno.*	7987	2200
Maſcali.	1300	15	*Trezza.*		200
Maſſa Nunziata	394	55	*Trecaſtagni.*	3264	1000
Militello Val di Noto.	6438	600	*Terra Nova.*	5289	
S. Michele.	1838	1	*Tremiſteri.*	996	90
Melilli.	5480	900	*Vittoria.* (*Grande.*	3950	200
Monteroſſo.	234	232	*Terra Grande o Viu*	1602	200
Modica.	18203	3400	*Vizzini.*	10678	2000
			Sum	254936	59963

An Earthquake at Lima, 1687. *By* P. Alvarez de Toledo. n. 209. p. 81.

XVIII. On *Monday*, *Octob.* 20. 1687, (*N. S.*) at 4 of the Clock in the Morning came a ~~horrible *Earthquake* and *Noiſe*, with which ſome~~ Houſes fell, and ſome Perſons were killed under the Ruins.

At 5 of the Clock in the ſame Morning was another Shake, with the ſame Noiſe.

At 6 of the Clock in the aforeſaid Morning, when we thought we had been all in Safety, came another Shake with great Fury and ruſhing Noiſe; the *Sea*, with great bellowing, came beyond its Bounds; the Bells rung of themſelves; and the Deſtruction was ſo great, that no Building ſtood. The *Noiſe* was ſuch, that thoſe in the Fields aſſure us, that the Cattle were in great Aſtoniſhment; *Callao*, *Canete*, *Piſco*, *Chancay*, and *Los Chorillos*, are all ruined. There are more than 5000 dead Bodies found, and they find more daily; ſo that we know not their Number.

An Earthquake in Jamaica, 1687-8. *By Dr.* Hans Sloan, n. 209. p. 81.

XIX. The Inhabitants of *Jamaica* expect an *Earthquake* every Year, *&c.* Some of them are of Opinion, that they follow their great Rains. One of them happened on *Sunday* the 19th of *Feb.* 168$\frac{7}{8}$, about 8 in the Morning. I found in a Chamber, one Story high, the Cabinets and ſeveral other Moveables on the Floor to reel, as if the Foundations of the Houſe had been raiſed. I looked out at a Window to ſee what was the Matter, and found that the Pidgeons and other Birds, in an Aviary hard by, were on their *Wings* in great Aſtoniſhment. It came by Shocks; there were three of them with a little Pauſe between: It laſted about a Minute of Time in all; and there was a ſmall Noiſe accompanied it. A Pair of Stairs higher it threw down moſt Things off the Shelves, and had much more viſible Effects than below. This was generally felt all over the Iſland at the ſame Time, or near it; ſome Houſes therein being cracked, and very near ruined; others being uncovered of their Tiles: Very few eſcaped ſome Injury; and the People in them were generally in a great Conſternation, ſeeing them dance. The Ships in the Harbour at *Port-Royal*, felt it; and one, who was Eaſtward of the Iſland, coming thither then from *Europe*, met with, as he ſaid, at the ſame time, an *Hurricane*. One riding on Horſe-back was not ſenſible of it. A Gentleman being at that Time abroad in his Plantation, told me, he ſaw the Ground riſe like the Sea in a Wave, as the *Earthquake* paſſed along, and that it went Northward; for that, ſome ſmall Time after he had felt it, he ſaw, by the Motion of the Tops of the Trees on Hills, ſome Miles diſtant, that it had then reach'd no farther than that Place. The *Spainards*, who inhabited this Iſland and thoſe neighbouring, built their Houſes very low, and they conſiſted only of Ground-Rooms, their Walls being made of Poſts, which were as much buried under Ground as ſtood above, on purpoſe to avoid the Danger which attended other manner of Building, from *Earthquakes*. And I have ſeen in the Mountains afar off bare Spots, which, the Inhabitants told me, were the Effects of *Earthquakes* throwing down Part of the Hills, which continued bare and ſteep.

An Earthquake in Jamaica, 1692. *By* - - - - n. 209. p. 83.

XX. 1. The terrible *Earthquake* which happened *June* 7. 1692, between 11 and 12 of the Clock at Noon, ſhook down and drowned 9 tenths of the Town of *Port-Royal* in two *Minutes* Time; and all by the *Wharf-ſide* in leſs than one: Very few eſcaped there. I loſt all my People and Goods, my Wife and two Men, Mrs. *B.* and her Daughter: One White Maid eſcaped; who gave me an Account, that her Miſtreſs was in her Cloſet, two Pair of Stairs high, and ſhe was ſent into the Garret, where was Mrs. *B.* and her Daughter, when ſhe felt the *Earthquake*, and bid her take up her Child, and run down; but turning about, met the Water at the Top of the *Garret Stairs*: for the Houſe ſunk downright, and is now near 30 Foot under Water. My Son and I went that Morning to *Liguania*; the *Earthquake* took us in the Mid-way between that and *Port-Royal*, where we were near being overwhelmed by a ſwift rolling Sea, 6 Foot above the Surface, without any Wind; but it pleaſed God to ſave us, being forced back to *Liguania*, where I found all Houſes even with the Ground; not a Place to put one's Head in, but in *Negro*-Houſes. The *Earth* continues (*June* 20.) to ſhake 5 or 6 times in 24 Hours, and often trembling. Great Part of the Mountains fell down, and fall daily. I pray God divert thoſe heavy Judgments which ſtill threaten us.

By - - - ib.

2. We have had a very great *Mortality* ſince the *Great Earthquake* (for we have little ones daily;) almoſt half the People, that eſcaped at *Port-Royal*, are ſince dead of a *Malignant Fever*, from Change of Air, Want of dry Houſes, warm Lodging, proper Medicines, and other Conveniences. *September* 3. 1692.

By - - - ib. p. 88.

3. A great Part of *Port-Royal* is ſunk; that, where the Wharfs were, is now ſome Fathoms of Water: All the Street where the Church ſtood is *overflowed*, that the Water ſtands ſo high as the upper Rooms of thoſe Houſes which are ſtanding. The *Earth*, when it opened, ſwallowed up People, and they roſe in other Streets; ſome in the Middle of the Harbour, and yet were ſaved; though at the ſame time I believe there was loſt about 2000, Whites and Blacks. At the North above 1000 Acres of Land ſunk, and 13 People with it. All our Houſes were thrown down all over the Iſland, that we were forced to live in Huts. The two great Mountains, at the entring into 16 *Mile-Walk*, fell, and met, and ſtopt the River, that it was dry from that Place to the *Ferry* for a whole Day, and vaſt Quantities of Fiſh taken up, which was greatly to the Relief of the Diſtreſſed. At *Yellows* a great Mountain ſplit, and fell into the level Land, and covered ſeveral Settlements, and deſtroyed 19 White People. One of the Perſons, whoſe Name was *Hopkins*, had his Plantation *removed* half a Mile from the Place where it formerly ſtood, and now good Proviſions grow upon it. Of all Wells, from one Fathom to 6 or 7, the Water flew out of the Top, with the great Motion of the *Earth*. Since it has continued ſhaking, ſometimes two or three times in a Day; ſo at Night, ſometimes more, ſometimes leſs; but, God be praiſed, they are but ſmall. Our People ſettled a Town at *Liguania-ſide*, and there are about 500 Graves already, and People are every Day a dying ſtill. *Sept.* 20. 1692.

By----ib. p. 85. 4. Between eleven and twelve a-Clock we felt the Tavern (where I then was) ſhake, and ſaw the Bricks begin to riſe in the Floor, and at the ſame Inſtant heard one in the Street cry, *An Earthquake.* Immediately we ran out of the Houſe, where ſaw all People with lifted-up Hands begging God's Aſſiſtance. We continued running up the Street, whilſt on either Side us we ſaw the Houſes, ſome ſwallowed up, others thrown on Heaps; the Sand in the Street roſe like the Waves in the Sea, lifting up all Perſons that ſtood upon it, and immediately dropping down into Pits, and at the ſame Inſtant, a Flood of Water breaking in, and rolling thoſe poor Souls over and over; ſome catching hold of Beams and Rafters of Houſes, others were found in the Sand that appeared, when the Water was drained away, with their Legs and Arms out; we beholding this diſmal Sight: The ſmall Piece of Ground, whereon 16 or 18 of us ſtood (God be praiſed) did not ſink. As ſoon as the violent Shake was over every Man was deſirous to know if any Part of his Family were left alive. I endeavour'd to go towards my Houſe upon the Ruins of the Houſes, that were floating upon the Water, but could not: At length I got a *Canoa*, and row'd up the great Sea-ſide towards my Houſe, where I ſaw ſeveral Men and Women floating upon the Wreck out to Sea; and as many of them, as I could, I took into the Boat, and ſtill rowed on, till I came where I thought my Houſe had ſtood, but could hear of neither my Wife nor Family. Next Morning I went from one Ship to another, till at length it pleaſed God that I met with my Wife and two of my Negroes. She told me, when ſhe felt the Houſe ſhake ſhe ran out, and called all the Houſe to do the ſame: She was no ſooner out, but the Sand lifted up, and her *Negro* Woman graſping about her, they both dropt into the *Earth* together; and at the ſame inſtant the Water coming in rolled them over and over, till at length they catched hold of a Beam, where they hung till a Boat came from a *Spaniſh* Veſſel and took them up.

The Houſes from the *Jews-ſtreet* End to the *Breaſt-work* were all ſhaked down, ſave only 8 or 10, that remained from the Balcony upwards above Water: And, as ſoon as the violent *Earthquake* was over, the Watermen and Sailors did not ſtick to plunder thoſe Houſes; and in the Time of their Plunder one or two of them fell upon their Heads, by a ſecond *Earthquake*, where they were loſt.

As ſoon as the violent Shake was over the Miniſter deſired all People to join with him in Prayer; and amongſt them were ſeveral *Jews* that kneeled, and anſwered as they did; nay, I heard one ſay, they were heard to call upon *Jeſus Chriſt*: A Thing worth Obſervation!

Several Ships and Sloops were overſet, and loſt in the Harbour: Amongſt the reſt the *Swan Frigat*, that lay by the Wharf to careen, by the violent Motion of the Sea, and ſinking of the Wharf, was forced over the Tops of many Houſes; and paſſing by the Houſe where my Lord *Puke* lived, Part of it fell upon her, and beat in her Round Houſe: She did not overſet, but helped ſome hundreds in ſaving their Lives.

As to the *Fire-Balls*, which you heard were ſeen in the Air, it was a great Falſhood; but a great and hideous Rumbling was heard in the Mountains, inſomuch that it frighted many Negroes that had been run away ſome Months from their Maſters, and made them come home.

The *Water*, that *iſſued* from the *Salt-Pan-Hills*, forced its Paſſage in, I believe 20 or 30 ſeveral Places, ſome more forcibly than others: For in 8 or 10 Places it came with that Violence, that had ſo many Sluices been drawn up at once, they could not have run with greater Force, and moſt of them 6 or 7 Yards high from the Foot of the Hill: 3 or 4 of the leaſt of them we obſerved were near 10 or 12 Yards high in the Mountain. We taſted the Water in moſt of the Places, and found it to be brackiſh. It continued running that Afternoon, all Night, and till next Morning about Sunriſe, at which time the *Salt-Pans* were quite overflowed.

The Mountains betwixt *Spaniſh-Town* and 16 *Mile-Walk*, as the Way lies along the River, if you remember, about the mid-way they are almoſt perpendicular, eſpecially on the other Side the River; thoſe two *Mountains* in the *violent Shake* of the *Earthquake* joined together, which ſtopt the Paſſage of the River, and forced it to ſeek another, which was a great Way in and out amongſt the Woods and *Savana's*; for (as I have heard by ſeveral Hands) it was 8 or 9 Days before the Town had any relief from it: Inſomuch that, before it came, the People were in thoughts of removing into the Country, concluding it had been ſunk as *Port-Royal* was. The *Mountains* along the River are ſo *thrown on Heaps*, that all People are forced to go by *Guanaboa* to the 16 *Mile-Walk.*

Mr. *Bosby* (who with his Wife had a miraculous Eſcape) told us, that that Afternoon, coming to his Plantations, he found the Ground opened in ſeveral Places; and in one, two *Cows* were dropt in and ſmothered.

The *Weather* was much hotter after the *Earthquake* than before; and ſuch an innumerable quantity of *Muſquetoes*, that the like was never ſeen ſince the Inhabiting of the Iſland.

The *Mountains* at *Yellows* far'd no better than thoſe of 16 *Mile-walk*; a great Part of one of them falling down drove all the *Trees* before it, and at the Foot of the *Mountain* there was a Plantation that was wholly overthrown and buried in it.

The *Mountains* in *Liguania* fell in ſeveral Places, and in ſome very ſteep. Ib. p. 88.

The *Water* in the Streets in *Port-Royal* did not ſpout up as you have heard, but in the *violent Shake* the *Sand* cracking and opening in ſeveral Places where People ſtood, they ſinking into it, the *Water* boiled out of the *Sand*, that covered many and ſaved others.

By —— *Communicated by Dr.* Love Morley. ib. 89.

5. The Year 1692 began in *Jamaica* with very dry and hot Weather, which continued till *May*, when there was very *blowing Weather* and much Rain till the End of the Month; from which Time, till the *Earthquake* happened, 'twas exceſſive hot, calm and dry; and on *Tueſday* the *7th* of *June*, about 40 Minutes paſt 11 in the Forenoon, it being then a very hot, clear, Sun-ſhine Day, ſcarce a Cloud to be ſeen in the *Sky*, or a Breath of Air to be felt, happen'd that *Great Shake*, ſo fatal to this Place, and to the whole Iſland.

It began with a ſmall trembling, ſo as to make People think there was an *Earthquake*, which Thoughts were immediately confirmed by a ſecond *Shake* ſomething ſtronger, accompanied all the while with a *Hollow Rumbling Noiſe*, almoſt like that of Thunder, which made them begin to run out of their Houſes. But alas! this was but ſhort Warning for them to provide for their Safety; for at the Heels of this ſecond came the *Third Violent Shake*, which in leſs than a Minute's Time (it continuing near a Minute) ſhook the very *Foundation* of *Port-Royal* in ſuch a Sort, that I believe 3 Parts in 4 of the Houſes and the Ground whereon they ſtood, and moſt Part of thoſe who inhabited them, all ſunk at once quite under Water; and on the Place which was left, and is now ſtanding, ſhook down and ſhatter'd the Houſes in ſo violent a Manner, that at our Landing it looked more like a Heap of Rubbiſh, than any thing elſe; there being, I believe, ſcarce one Houſe in ten left ſtanding, and thoſe ſo crack'd and ſhatter'd, that few of them were fit, or thought ſafe to live in, and ſtand now (*July* 3. 1693) empty. All thoſe Streets which were next the *Water*, towards the *Harbour-ſide*, where there were excellent *Wharfs*, cloſe to which *Ships* of 700 Tun might lie and deliver their Loading, where were the beſt Store-Houſes and Conveniencies for Merchants, where were brave ſtately Buildings, where the Chief Men of the Place lived, and which were in all Reſpects the principal Parts of *Port-Royal*, now lie in 4, 6, or 8 *Fathom Water*. That Part which is now ſtanding is Part of the End of that Neck of Land which runs into the Sea, and makes this *Harbour* (at the Extremity of which ſtands the *Fort*, not *ſhook* down, but much *ſhatter'd* by the *Earthquake*) and is now a perfect Iſland; the whole Neck of Land, from the *Fort* of *Port-Royal* now ſtanding to the *Palliſadoes*, or other End of *Port-Royal* towards the Land (which is above a Quarter of a Mile) being quite diſcontinued and loſt in the *Earthquake*; and is now alſo with all the Houſes, which ſtood very thick thereon, quite under *Water*: All which Part or Neck of Land (which is diſcontinued) as alſo all the other Parts of this Place which *ſunk*, were, for what I can learn, nothing but perfect *Sands*; and, by the People driving down Timber and Wharfing, &c. were by little and little gained in time out of the *Sea*, which now has at once recovered all again.

Capt. *Hals* and ſome others ſay, that, when they came hither with *Venables*, the Place, whereon *Port-Royal* was ſince built, was like one of the Keys or little Iſlands that lie off this *Harbour* (which by the Way are all ſtanding) but continued by a ſmall Ridge of *Sand*, which then juſt appear'd above *Water*, with the other Part of the Neck of Land, and I believe there is now as much Ground left ſtanding as then.

And one, who had been there ſome Years before under one *Jackſon* (who took and plundered *St. Jago*, &c.) and returned with *Venables*, told Capt. *Hals* at his coming hither, that the *Point* or Place now ſtanding, when he was here before under the ſaid *Jackſon*, was wholly ſeparated from the Land by the *Sea* (as it is at this Time;) and, pointing to the Ridge of *Sand* above-mention'd, ſaid, That did not appear when I was here before. This is very probable; for already, ſince the *Earthquake*, the *Sandy Ground* at the *Palliſadoes*, or other

Side, hath gained from the *Sea* ſeveral Acres. On this *Sandy* Neck of Land did People build great heavy Brick-Houſes; whoſe Weight upon ſo *Sandy* a Foundation may be ſuppoſed to contribute much to their downfall; for the Ground gave way as far as the Houſes ſtood only, and no further; Part of the *Fort* and the *Palliſadoes*, at the other End of the Houſes, ſtanding.

This Part of *Port-Royal*, which is now ſtanding, is ſaid to ſtand upon a Rock: But alas! the ſtrange *Rents* and *Tearings* of the *Mountains* here ſufficiently evince, that *Rocks* and *Sands* are equally able to withſtand the Force of a *Violent Earthquake*. If this Place be nothing but *Sand* (as ſome would have it, that are its no Well-Wiſhers) it ſeems ſtrange that the Force of the *Earthquake* did not diſſipate and diſſolve the very Foundation of it, and that it did not fall to Pieces and ſcatter under *Water*, as the reſt of the Place did; for the *Shake* was ſo violent, that it threw People down on their Knees, and ſometimes on their Faces, as they ran about the Streets to provide for their Safety; and it was a very difficult Matter to keep one's Legs. The Ground heaved and ſwell'd like a rolling ſwelling *Sea*; ('tis a ſtrange Compariſon; but, every Body here uſing it, I venture to do ſo likewiſe) by which means ſeveral Houſes now ſtanding were ſhuffled and moved ſome Yards from their Places. One whole Street (a great many Houſes whereof are now alſo ſtanding) is ſaid to be twice as broad now as before the *Earthquake*; and in many Places the Ground would crack, and open and ſhut, quick and faſt: Of which ſmall Openings I have heard Major *Kelly* and others ſay, they have ſeen 2 or 3 Hundred at one Time; in ſome whereof many People were ſwallowed up; ſome the *Earth* caught by the Middle, and ſqueezed to death; the Heads of others only appeared above Ground; ſome were ſwallowed quite down, and caſt up again with great Quantities of Water; others went down, and never were more ſeen: Theſe were the ſmalleſt Openings. Others, that were more large, ſwallowed up great Houſes; and out of ſome Gapings would iſſue forth whole Rivers of *Water*, ſpouted up a great Height into the Air, which ſeemed to threaten a Deluge to that Part of *Port-Royal* which the *Earth* ſeemed to favour, accompanied with ill Stenches and offenſive Smells: By means of which Openings, and the Vapours at that Time belch'd forth from the *Earth* into the *Air*, the Sky, which before was clear and blue, was in a Minute's Time become dull and reddiſh (as I have heard it compared often) like a red-hot Oven. All theſe dreadful Circumſtances occurring at once, accompanied all the while with prodigious loud *Noiſes* from the *Mountains*, occaſioned by their Falling, &c. and alſo a hollow *Noiſe* under Ground, and People running from one Place to another, with Fear looking like ſo many Ghoſts, and more reſembling the Dead than the Living, made the whole ſo terrible, that People thought the Diſſolution of the whole Frame of the World was at hand. Indeed 'tis enough to raiſe melancholy Thoughts in a Man now, to ſee the *Chimneys* and *Tops* of ſome *Houſes*, and the *Maſts* of *Ships* and *Sloops*, which partook of the ſame Fate, appear above Water; and, when one comes firſt aſhore, to ſee ſo many Heaps of Ruins, many whereof by their largeneſs ſhew, that once there had ſtood a brave Houſe; to ſee ſo many Houſes ſhatter'd, ſome half fallen down, the reſt deſolate and without Inhabitants; to ſee where Houſes have been ſwallowed up, ſome appearing half above Ground, and of others the Chimneys only; but above all to ſtand on the Sea-ſhore, and to look over that Part of the Neck of Land, which for above a Quarter of a Mile was ſwallowed up; there, where once brave Streets of ſtately Houſes ſtood, appearing now nothing but Water, except here and there a Chimney, and ſome Parts and Pieces of Houſes, ſerving only to mind us of their ſad Misfortune.

And tho' *Port-Royal* was ſo great a Sufferer by the *Earthquake*, yet it left more Houſes ſtanding there, than in all the Iſland beſides. It was ſo violent in other Places, that People could not keep their Legs, but were violently thrown down on the Ground, where they lay on their Faces with their Arms and Legs ſpread out, to prevent being tumbled and thrown about by the incredible Motion of the *Earth*, like that as is the general Compariſon of a great Sea. It ſcarce left a Planter's Houſe or Sugar-Work ſtanding all over the Iſland. I think it left not a Houſe ſtanding at *Paſſage-Fort*, and but one in all *Liguania*, and none in *St. Jago*, except a few low Houſes built by the wary *Spaniards*. And 'tis not to be doubted, but that, had there been 500 or 5000 Towns in *Jamaica*, the *Earthquake* would have ruin'd every one. In ſeveral Places in the Country the *Earth* gaped prodigiouſly: On the North-ſide the Planters Houſes, with the greateſt Part of their Plantations (and the Planters Houſes are not very near to one another) were *ſwallowed*, Houſes, People, Trees, all up in one Gape; inſtead of which appeared for ſome time after a great Pool or Lake of Water, covering above 1000 Acres, which is ſince dried up, and now is nothing but a looſe *Sand* or *Gravel*, without any the leaſt Mark or Sign left, whereby one may judge that there ever had ſtood a Tree, Houſe, or any thing elſe. In *Clarendon* Precinct the *Earth* gaped and ſpouted up with a prodigious Force great Quantities of *Water* into the Air, about 12 Miles from the *Sea*; and all over the Iſland there were abundance of Gapings or Openings of the *Earth*, many thouſands; Marks of many whereof, which upon their cloſing they left behind them, any one cannot chuſe but ſee that goes into the Country; and I have ſeen ſeveral. But in the *Mountains* are ſaid to be the moſt violent Shakes of all; and 'tis a generally received Opinion, that the nearer to the *Mountains* the greater the *Shake*; and that the Cauſe thereof, whatever it is, lies there. Indeed they are ſtrangely torn and rent, inſomuch that they ſeem to be of quite different Shapes now from what they were; eſpecially the *Blue*, and other *Higheſt Mountains*, which ſeem to be the greateſt Sufferers; which, during the Time of the firſt great *Shake*, and as long as the great *Shakes* continued, which was above two Months after the firſt *Shake*, (during which Time the *Shakes* came very ſtrong and thick, ſometimes 2 or 3 in an Hour) bellowed out prodigious loud *Noiſes* and *Eccboings*.

Not far from *Yellows*, Part of a *Mountain*, after having made ſeveral *Leaps* or *Moves*, overwhelmed a whole Family, and a great Part of a Plantation, lying a Mile off: and a large *High Mountain*, near *Portmorant*, near a Day's Journey over, is ſaid to be quite *ſwallowed* up; and, in the Place where it ſtood, there is now a great *Lake* of 4 or 5 *Leagues* over.

In the *Blue Mountain*, and its nigh Neighbours, from whence came thoſe dreadful Roarings, terrible and amazing to all that heard them, may be reaſonably ſuppoſed to be many ſtrange Alterations of the like Nature: But thoſe wild, deſert Places, being very rarely or never viſited by any body, not by Negro's themſelves, we are yet ignorant of what happened there. But whereas they uſed to afford a fine green Proſpect, now one half Part of them at leaſt ſeemed to be wholly deprived of their natural *Verdure*. There one may ſee, where the Tops of great Mountains have fallen, ſweeping down all the Trees, and every Thing in their Way, and making a Path quite from Top to Bottom; and other Places, which ſeemed to be peeled, and bare, a Mile together: which vaſt Pieces of *Mountains*, with all the Trees thereon, falling together in a huddled and confuſed Manner, ſtopped up moſt of the Rivers for about 24 Hours, which afterwards having found out new Paſſages, brought down into the Sea, and this Harbour, ſeveral hundred thouſand Tun of Timber, as I have heard computed from the moſt knowing People there, which would ſometimes float into the Sea in ſuch prodigious Quantities, that they looked like moving Iſlands. I have ſeen ſeveral of thoſe large Trees on this Shore, all deprived of their Barks and Branches, and generally very much torn by the Rocky Paſſages, through which, by the force of a falling Stream and their own Weight, they might be ſuppoſed to be driven. One great Trunk of a Tree particularly, I have ſeen amongſt the reſt ſo ſqueezed as a Sugar-Cane after it had paſſed the Mill. Some are of Opinion that the *Mountains* are *ſunk* a little, and are not ſo high as they were; others think the whole Iſland is *ſunk* ſomething by the *Earthquake*. *Port-Royal* is ſaid to be *ſunk* a Foot, and in many Places in *Liguania*, I have been told, are Wells which require not ſo long a Rope to draw Water out of them now, as before the *Earthquake*, by 2 or 3 Foot.

In this Harbour in *Port-Royal* at the Time of the *Great Shake* (though the Seas were very calm) was ſuddenly raiſed ſuch a ſtrange *Emotion* in the Water, that immediately it ſwelled, as in a Storm, great large Waves appearing on a ſudden rolling with ſuch a Force, that they drove moſt Ships (if not all) in the Harbour from their Anchors, breaking their Cables in an Inſtant; but this was ſoon over, and in a little Time all was ſmooth again. One Capt. *Phips* told me, that he and another Gentleman happened at the Time of the *Earthquake*, to be in *Liguania* by the Sea-ſide; and that at the Time of the *Great Shake*, the Sea retired from the Land in ſuch Sort, that for 2 or 3 hundred Yards the Bottom of the Sea appeared dry, whereon they ſaw lie ſeveral Fiſh, ſome whereof the Gentleman who was with him ran and took up, and in a Minute or two's Time the Sea returned again, and overflow'd great Part of the Shore. At *Yallhouſe* the Sea is ſaid to retire above a Mile.

'Tis thought there were loſt in all Parts of the Iſland 2000 People, and had the *Shake* happened in the Night, very few would have eſcaped alive.

Since my Arrival here I have felt ſeveral *Shakes*, the firſt and greateſt whereof was on *Good Friday*, 1693, it lifted me compleatly off my Chair, and ſet me on my Legs, and was ſaid to be a ſmall *Shake*: But I did not then hear the Noiſe (minding ſomething elſe) which always immediately foreruns or rather accompanies it; but I have ſince felt ſeveral leſs *Shakes*, and heard the *Noiſe* often, which is very loud, and may be eaſily taken, by thoſe not uſed to hear it for a ruffling Wind, or for a hollow rumbling Thunder; but hath ſome puffing Blaſts peculiar to itſelf, and are moſt like thoſe of a Match made of *Brimſtone*, when lighted, but in a much greater Degree, and ſuch as a large Magazine of *Brimſtone* may be ſuppoſed to make, when on fire. It is obſervable, that every ſmall *Shake* is felt on Ship-board as ſenſibly as on Shore, the *Water* ſhaking as well as the Land.

It is likewiſe obſerved, that in windy Weather there never comes a *Shake*, but in very calm Weather it is always expected. This Obſervation hath held true in every *Shake*, that hath happened ſince the firſt great one.

'Tis obſerved, that after Rain, they are generally ſmarter than at other times; which may be from the ſhutting up of the Pores of the *Earth*, whereby the Force is more pent in, and hath not ſo free a Paſſage as to perſpire and ſpend itſelf, *&c.*

Shakes often happen in the Country, not felt at *Port-Royal*; and ſometimes are felt by thoſe that live in and at the Foot of the *Mountains*, and by no body elſe.

'Tis obſerved, that ſince the *Earthquake*, the *Land-Breezes* often fail us, and inſtead thereof, the *Sea-Breezes* often blow all Night; a Thing rarely known before, but ſince common.

In *Port-Royal*, and in many Places all over the Iſland, much *Sulphureous* Combuſtible Matter hath been found, ſuppoſed to have been thrown out, upon the opening of the *Earth*, which upon the firſt touch of Fire would flame and burn like a Candle.

St. *Chriſtophers*, one of the *Caribee-Iſlands*, was heretofore much troubled with *Earthquakes*, which upon the *Eruption* of a great Mountain there of Combuſtible Matter, which ſtill continues, wholly ceaſed, and have never been felt there ſince: Wherefore many expect ſome ſuch Eruption in ſome of the Mountains here, though we hope there is no Neceſſity for it; the *Shakes* having been obſerved to loſe their Force, and to become weaker and weaker ever ſince the firſt fatal one; and 'tis now ſo long ſince we have heard any, except now and then one ſo weak as ſcarce to be felt, that we have great hopes they will now quite ceaſe.

After the great *Shake*, thoſe People that eſcaped, (as many as could) got on board the Ships in the Harbour, where many continued above 2 Months after; the *Shakes* all that time being ſo violent, and coming ſo thick, ſometimes two or three in an Hour's time, accompanied with frightful Noiſes, both from under the *Earth*, and from the continual falling and breaking of the *Mountains*, that they dared not come aſhore. Others went to the Place call'd *Kingſtown* (or by others *Killkown*) where, from the firſt clearing of the Ground, and from bad Accomodations, the Huts built with Boughs, and not ſufficient to keep out Rain, which in a great and an unuſual Manner followed the *Earthquake*, lying wet, and wanting Medicines, and all Conveniences, *&c.* they died miſerably in Heaps. Indeed there was a general *Sickneſs*, ſuppoſed to proceed from the hurtful Vapours belched from the many Openings of the *Earth*) all over the Iſland, ſo general that few eſcaped being Sick; and 'tis thought it ſwept away in many Parts of the Iſland, 3000 Souls; the greateſt Part from *Kingſtown* only, yet an unhealthy Place. Beſides the great Quantities of dead People floating from one Side of the Harbour to the other, as the *Sea* and *Land-Breezes* blew them, ſometimes 100 or 200 in a Heap, may be thought to add ſomething to the *Unhealthfulneſs* of that Place. *July* 3. 1693.

By Dr. Sloan ib. p. 80.

6. Moſt of the *Ships* loſt their Anchors and Cables which were towards the Wharfs or Town, which I ſuppoſe came from the Sands and Houſes falling on them; and they, after the *Earthquake*, rode in fewer Fathoms Water than before: And one may believe that ſome of the *Phænomena* may be accounted for from that.

An Earthquake in 1699. *at* Batavia; *ſent to* M. Nich. Witzen, *By* * * * * n. 264. p. 595.

XXI. The *Earthquake* which happen'd between the 4th and 5th of *Jan.* 1699. hath had ſtrange Effects about the *Tungarouſe* and *Batavian Rivers.* The great *Batavian* River from above *Tangala Warna*, being a Place from whence the ſaid River received the greateſt Part of its Water, is ſtopt up, or covered with *Earth* from the *Faln Hills*, till beyond the River *Tſyquſpokitſyl*; ſo that the Place where the River had its Courſe formerly, was not to be ſeen. But far beyond that Hill, towards *Batavia*, the Water comes forth again from under the *Earth*, which is ſunk down, but thick and muddy; paſſing over and thorough the Trees wherewith the River was formerly ſtopt up. The Trees lying in the River are of a ſpecial Bigneſs, and ſo cloſe packt together, that it is impoſſible to conceive how they came ſo.

From the Mountains ſituated near the Beginning of the *Batavian River*, called by the *Javaniians Sonſy-tſialiwong*, ſeven Hills are ſunk down, *viz.* 5 on this Side, and 2 on the other. But the *Mount* from whence the River hath alſo its Source, above *Tangel Warna*, within the Mountain *Terbackti*, is not ſunk down, nor hath received any Damage.

The *Tangarang* River, call'd by the Natives *Songbi Selani*, is alſo ſtopt up, and covered with *Earth*, from the Hill and Branch *Salack*, to the River *Antum*, and from thence to *Tangarang*, being fill'd up with Trees; but not in ſo much a Quantity, nor ſo cloſe together, as in the *Batavian* River: On this Side the *Tangarang* River, 9 are ſunk down by the *Earthquake*; and ſeven Branches, that had formerly their Iſſue in the River *Tangarang*, are alſo covered with the *Earth*, but three other Hills, lying alſo on this Side of the ſame River, and call'd *Minjan*, *Dauw*, and *Halſichi*, had not ſuſtained any Damage, whereby the Branches *Autan*, and *Kaniki*, (the latter into the firſt Branch, and the firſt into the River *Tangarang*) have kept their Courſe: And the Hill *Oudjong-teboc*, being call'd alſo *Sedani*, from whence the *Tangarang* River had its Source, is not ſunk down nor hurted. It is alſo obſerved, in the *Tangarang* River, at the Place where it is ſtopt up with Trees, that the deſcending Water being thick and muddy, went backward with a Motion not unlike the Waves of the Sea, when moved by a Tempeſt.

The High-Land between the *Batavian* and *Tangarang* Rivers, behind the old Court of the *Jacatra* Kings, called *Pakowang*, having been a great Wood, is changed ſince the *Earthquake*, into a great and open Field, wholly deſtitute of Trees, the Surface of the Ground being covered with a red Clay, ſuch as the Maſons uſe here; which in ſome Places was ſo hard, that it could endure treading and going upon it, and in other Places Men did ſink above a Foot in it. And in the Place of the old Court called *Pakowang* ſituated between the *Batavian* and *Tangarang* Rivers, no other Damage hath been ſeen, than that the Land thereabouts hath been *rent* and divided aſunder with great Clefts more than a Foot wide. The River *Tſicome*, proceeding from a Pit or Well in the aforeſaid Court of *Pakowang*, and running a great Way under Ground, and then coming forth again, taking its Courſe towards *Anke*, had not received any harm: But kept its Courſe uninterrupted.

The *Tommagon Porbo Nata* in his going towards the Mountains, heard a Noiſe like unto Thunder, and fearing that a ſinking down of the Ground, or an Eruption of Water would follow, he ſtood ſtill with thoſe that were about him, and ſaw afterwards that the *Earth* from the Top of the Mountains ſunk down; and hearing no further Noiſe, he went on his Journey, having in going and coming back ſpent 19 Days by the Way, and felt 40 Times an *Earthquake*: And ſince his return from the Mountains, he hath felt the like *Shaking* 208 Times.

The Cauſe of Earthquakes and Vulcano's; By Dr. Mart. Liſter. n. 157. p. 512. *De Font. Med.* Angl.

XXII. I have elſewhere ſhewn, that the *Breath* of the *Pyrites* is *Sulphur ex tota Subſtantia*; alſo that it naturally takes fire of itſelf: Again that the material Cauſe of *Thunder* and *Lightning*, and of *Earthquakes*, is one and the ſame; *viz.* the *inflammable Breath* of the *Pyrites*. The Difference is, that one is fired in the Air, the other under Ground: Of which laſt, theſe (I think) are ſufficient Arguments; A Thing burnt with *Lightning* ſmells of very Brimſtone: again the Subtilty and Thinneſs of the Flame; alſo the Manner of its burning, which is often obſerved to be *Particulatim*, or in ſmall Spots, Vapour like. And of *Earthquakes*, the Sulphureous Stink of Waters ſmelt before, and of the very Air itſelf after them: Of which innumerable Inſtances occur in the Relations of them.

They alſo agree in the Manner of the Noiſe, which is to be carried on, as in a Train fir'd, the one rolling and rattling through the Air, taking fire as the Vapours chance to drive, as the other fired under Ground in like Manner moves with a deſultory Noiſe, as it ſhall chance to be continued.

That the *Earth* is more or leſs hollow, is made probable, by what is found every where in the Mountains, *viz.* Natural *Cavities* or *Chambers*, which the Miners of the *North* call *Self-Opens*. Theſe they meet with frequently, ſome vaſtly great, and others leſs, running away with ſmall *Sinus*'s: And I doubt not, but upon diligent Enquiry, a great Catalogue of ſuch might be had, diſcovered in the Memory of Man. Beſides, many there are, which are known to open to the Day, and to diſcover themſelves without Digging, as *Pool's-Hole*, *Okey-Hole*, &c. Again, the great and ſmall Streams, which do ariſe from under the Mountains, do evidence the *Hollowneſs*, and *Sinouſneſs* of them. Add to theſe, that many *Sinus*'s are made in that Inſtant, and are continued by the Exploſion and rending of the firſt Matter fired; which may, and do very probably, cloſe again, when the Force of that *Exploſion* is over, but are ſufficiently open to continue the *Earthquake*.

That theſe *ſubterraneous Cavities* are at certain Times and in certain Seaſons full of *inflammable Vapours*, the *Damps* in our *Mines* ſufficiently witneſs, which fired do every Thing as in an *Earthquake*, ſave in a leſſer Degree.

Now, that the *Pyrites* alone which is our preſent Task) of all the known Minerals, yields this *inflammable Vapour*, I think highly probable, for theſe Reaſons.

1. Becauſe no Mineral or Ore whatſoever is *Sulphureous*, but as it is wholly, or in Part, a *Pyrites*: I have carefully made the Experiment in very many of the Foſſils of *England*, and I do find them all to contain Iron, wherever there is *Brimſtone*.

2. Becauſe there is but one Species of *Brimſtone*, that I know of, at leaſt with us in *England*: And ſince the *Pyrites* naturally and only yields it, it is but reaſonable wherever *Brimſtone* is found, though in the Air or under Ground in Vapour, to think that alſo proceeds from it. The *Sulphur Vive* or *Natural Brimſtone*, which is found in and about the *Burning Mountains*, is certainly the Effects of *Sublimation*, and thoſe great Quantities of it ſaid to be found about the Skirts of *Vulcano's*, is only an Argument of the long Duration, and Vehemency of thoſe Fires. And though the *Sulphur Vive* or *Rough Brimſtone*, as they call it, had from *Hæcla* and *Italy* is Opakue, and agrees not with the Tranſparent and Amber-like *Sulphur Vive* of the Ancients; yet it does not follow, that that alſo was not produc'd by *Sublimation*, no more, than that the *Stalactites*, or Water-wrought Stone, is not ſo made, for that ſome of it is Opake, and ſome Chryſtalline.

But poſſibly the *Pyrites* of the *Vulcano*'s or *Burning Mountains*, may be more *Sulphureous* than ours. And indeed it is plain, that ſome of ours in *England* are very lean, and hold but little *Sulphur*; others again very much. And this may be one Reaſon, why *England* is ſo little troubled with *Earthquakes*, and *Italy*, and almoſt round the *Mediterranean-Sea*, ſo very much. Another Reaſon is the Paucity of *Pyrites* in *England*; where they are, indeed, ſome little in all Places, but moſtly *ſparſim*; and if perchance in *Beds*, theſe are comparatively thin, to what probably they are in the *Burning Mountains*, as the vaſt Quantity of *Sulphur* thence *ſublim'd* doth ſeem reaſonably to imply. Alſo, if we compare our *Earthquakes*, and our *Thunder* and *Lightning* with theirs; there it *lightens* almoſt daily, eſpecially in Summer Time, here ſeldom; their *Thunder* and *Lightning* is of long Duration, here ſoon over; there the *Earthquakes* are frequent, long, and terrible, with many *Paroxiſms* in a Day, and that for many Days; here very ſhort, a few Minutes, and ſcarce perceptible. To this Purpoſe the *Subterraneous Cavities* in *England* are ſmall, and few compared to the vaſt Vaults in thoſe Parts of the World; which is evident, from the ſudden Diſappearance of whole Mountains and Iſlands.

There are indeed other *inflammable* Minerals beſides the *Pyrites*: But by the Providence of God, not to be found in *England*, that I know of, and not in any Quantity in any Place of the World, that I can learn; which is well for Mankind, becauſe they are very *Poiſons*, as the *Orpiments*: But they are ſpecifically diſtinct from *Brimſtone*, which no *Ore* yields but Iron; ſo the *Orpiments* are all *Gold Ore*. And by the Bye, ſome Authors have aſſign'd this as a good Reaſon, againſt any Medicine that ſhall be made out of *Gold*, (as fond as we are of an *Aurum Potabile*) as having naturally a deleterious Quality.

It may be objected, that no Body is *kindled by itſelf*: But it ſeems to me apparently otherwiſe; for that *Vegetables* will heat and take fire of themſelves, as in the frequent Inſtance of wet Hay; and *Animals* are naturally on Fire, and Man doth then ſufficiently demonſtrate it, when in a Fever: And amongſt *Minerals*, the *Pyrites*, both in Groſs and in Vapour, is actually of its own accord fir'd. Dr. *Power* has recorded at large, in his *Micrographia* a famous Inſtance of it; and the like not very rarely happens. And that *Damps* naturally fire of themſelves, we have the general Teſtimony of *Miners* and the ſame *Author*.

Again, the *Vulcano*'s, all the World over, argue as much; for we, with great Probability, believe them to be Mountains made up in great Part of *Pyrites*, by the Quantities of *Sulphur* thence *ſublim'd*, and the Application of the *Loadſtone* to the *ejected Cinder*. I go further:

That theſe *Vulcano*'s were *naturally kindled* of themſelves, at or near the Creation, is probable: Becauſe there is but a certain known Number of them which have all continued burning beyond the Memoirs of any Hiſtory; few or none of them that I know of, have ever totally decay'd or been extinct (unleſs poſſibly by the *Submerſion* of the Whole, being abſorb'd in the Sea. Though they, indeed, do burn more fiercely ſometimes than at others, for other Reaſons. So that it ſeems to me as natural, to have *actual Fire* in the *Terreſtial* World from the Creation, as to have Sea and Water.

Again, if theſe *Vulcano*'s did not *kindle of themſelves*, what Cauſe can we imagine to have done it; If the Sun; we anſwer, *Hæcla* placed in ſo extream cold a Climate was *kindled*, for ought I can ſee by the natural Hiſtory of both, as ſoon as *Ætna* or *Fuegos*, or the moſt Southerly.

Not the Accidents happening from Man; for, if Man was (as we muſt believe) created Solitary and Topical, they were none of his Kindling, becauſe they ſeem to be fired before the World could be all over peopled: Beſides they are moſtly the very Tops of vaſt high Mountains, and therefore the moſt unfit for the Habitation of Man.

If we ſay *Lightning*, and *Thunder*, or *Earthquakes*; we beg the Queſtion: For the Cauſe of the one is the Cauſe of the other; and they are one and the ſame. It remains therefore (very probable) that they were *kindled of themſelves*.

I for my Part know no Subject in the whole Mineral Kingdom ſo general and laſting for the Fuel of theſe Mountains, as the *Pyrites*; which I have ſaid alone does yield *Sulphur*, and naturally reſolves itſelf into it, by a kind of Vegetation.

About the *Durable Burning* of the *Pyrites* theſe are Inſtances: *Scotch Coal* hath leſs of the *Pyrites* in it, being moſtly made up of *Coal Bitumen*, and therefore it burns and conſumes quickly, and leaves a white Cinder. Sea-Coal, or that Coal which comes from *Newcaſtle* by Sea to us, and for that Reaſon ſo called, burns ſlowly; and the *Sunderland* Sea-Coal ſo ſlowly, that it is ſaid, by Proverb, to make three Fires; this hath much *Pyrites* mixt with it, and burns to a heavy reddiſh Cinder, which is Iron, by the *Magnet*. But I have ſeen, and have a Specimen by me of a Coal from *Ireland*, (the Proprietor of the Pits is Sir *Chriſtopher Wandsford*) which is ſaid to be ſo laſting, that it will continue 24 Hours red-hot, and almoſt keep its Figure: This ſeems to be in great Part *Pyrites* by the Weight and Colour.

XXIII. In the *Moores* from *Yeovil* towards *Bridgewater*, in the extreme Drought we have endured this Summer 1666, ſome Lengths of Paſture grew much ſooner withered and parched than the other Paſture. And this parched Part ſeemed to bear the Length and Shape (in groſs) of Trees. They digg'd and found in the Place Oaks indeed, as black as *Ebony*. And hence they have been inſtructed to find and take up many Hundreds of Oaks.

Subterraneous Oakes in Somerſetſhire; *By Dr.* J. Beal. n. 18. p. 323.

XXIV. In that *Fenny Tract*, called the *Iſle of Axholme*, lying Part in *Lincolnſhire*, and Part in *Yorkſhire*, has been Abundance of Oak, Firr, and other Trees, of late frequently found in the *Moore*; whereof ſome Oaks are 5 Yards in compaſs, and 16 Yards long; others ſmaller and longer, with good Quantities of *Acorns* near them, lying ſomewhat above 3 Foot in depth, and near their Roots, which do ſtill ſtand as they grew, *viz.* in firm *Earth* below the *Moore*. The *Firrs* lie a Foot or 18 Inches deeper, more in Number than Oak, and many of them 30 Yards long, one of them being, not many Years ſince, taken up of 36 Yards long, beſides the Top, lying alſo near the Root, which ſtood likewiſe as it grew, having been burnt and not cut down; as the Oak had been alſo. Mr. *Dugdale* concludeth, that this *Moore* hath been ſo for divers hundreds of Years, and that the Cauſe thereof has been the Muddineſs of the *Tides*, which flowing up *Humber* into *Trent*, left in Time ſo much Filth, as to obſtruct the Currents of *Idle*, *Dun*, and other Rivers, which thence flowed back and over-whelmed that flat Country.

Wood found under Ground in Lincolnſhire, *By* * * * * n. 67. p. 2050.

Of Draining the Fenns.

XXV. At *Youle* about 12 Miles below *York*, near the Place where the *Dun* empties itſelf into the *Humber*, there are ſeveral Perſons which are call'd *Tryers*, who, with a long Piece of Iron, ſearch in the ſoft and boggy Ground for *Subterraneous Trees*; and by this Way of Tryal, can in a great Meaſure diſcover the Length and Thickneſs of theſe Trees, and get a Livelihood by it. Some are ſo large that they are uſed for Timber in building Houſes, which is ſaid to be more durable than *Oak* itſelf; others are ſplit into *Laths*; others

Foſſile Wood near York; *By Dr.* Richardſon. n. 228. p. 526.

are cut into long *Chips*, and tied up in Bundles, and ſent to the Market-Towns ſeveral Miles off, to light Tobacco. Thoſe that I viewed were all broken off from the Roots; I ſuppoſe by Violence of Storm or Water, or both; and upon Enquiry do find, that they are all after the ſame Manner. Theſe *Tryers* do affirm, that at three or four Yards deep they find *Stumps* of *Trees* broken off; ſome two, three or four Foot from the Ground, and to be exactly the ſame Wood with the *Subterraneous Trees*. The *Bate* or Texture of this Wood is the ſame with *Firr*, eaſily *ſplitting*: If burnt it ſends out the ſame *Reſinous Smell*, and it affords the ſame Coal. The Branches generally grow in Circles, as the Knots do teſtify: The Knots do eaſily part from the reſt of the Wood, as is uſual in *Firr-Wood*. The Straightneſs and Length of theſe *Trees*, are alſo a Preſumption, that they muſt be ſuch; if one conſider that ſome of theſe are nigh a hundred Foot long, and at the Bottom not much above a Foot in Diameter. They affirm'd to me, that their Tops lay all one Way, (*viz.*) with the Current of the Water. There are alſo *Oaks* found there, though not in ſo great a Quantity. The *Vitriolick* Parts of the *Earth*, in which they have lain, hath given them a black Tincture quite through, which (when wrought and poliſhed fine) is not much inferior to *Ebony*. This Wood doth not emit the ſame Smell when burnt, with that call'd *Firr-Wood*; therefore I hope the Smell of that Wood will not be attributed to the *Bituminous* Parts of the *Earth* in which it hath lain. About 60 or 70 Years ago, ſeveral *Dutchmen* undertook to *drain* a large Marſh in that Place; and in cutting a Channel in the dry Ground betwixt the *Fen* and the River, at the firſt they threw up a *Rich* and *Firm Soil*, afterwards they met with a Stratum of *Sand*, under that a Stratum of *Boggy* Ground, in which they found of theſe *Subterraneous Trees*, and under that *Firm* Ground; and a Gentleman atteſted unto me, who had it from ſeveral Perſons then living, that were Eye-Witneſſes, that the *Firm* Ground in ſome Places lay *Ridge* and *Furrow*. There are ſeveral of theſe *Roots* of *Trees* to be ſeen in the Channel at Low-Water to this Day, and yet there are neither *Firr* nor *Pine* growing naturally here, nor have been in the Memory of any Man; neither doth there remain any Tradition of the Growth of any ſuch.

Foſſile Wood in Craven; *By Dr.* M. Liſter, n. 224. p. 381.

XXVI. *Pimco* is one of the higheſt Mountains in *Craven* in *Yorkſhire*, lying on the South-ſide of that Country, ſome two Miles above *Carleton*. On the South-ſide of the *Pike*, (as they call the very Top of that Mountain) is a Place where the *Water* ſtands; this is called a *Moſs*, and is ſome Fathoms perhaps deep in black Mud. Here are dug up, if we will believe the Inhabitants, not only *Roots*, but whole *Trees* of *Firr*.

I ſaw there no ſmall Marks of a Wood in former Ages; as the *Roots* or *Stumps* of *Trees* appearing above Ground; which upon due Examination of the Grain and Bark, I found to be the *Roots* of *Birch*. Theſe *Roots* ſplit eaſily, and ſome dry; and when dried, they burn with a *laſting Flame*: and for this Purpoſe they uſe them upon any ſudden Occaſion about their Houſes. And altho' the *Flame* be great, yet it is without any *Reſinous Smell*: However, it ſeems, that their having lain ſo long under Ground, has prepared the Juice for *burning*. There have been *Oaks*, as I have been told, dug up hereabouts alſo, but I ſaw none.

XXVII. On the South-ſide of the *Mendip-Hills*, at a Place call'd *Doulton*, there are great Quarries of *Free-ſtone*, where the Workmen at five or ſix Fathom deep, ſawing Stones of four or five Tun Weight, have often found large Pieces of cleft and fair Oak in the midſt of them.

Wood found in Stone, by Mr. J. Beaumont, *Ph. Col.* n. 2. p. 6.

XXVIII. *S. Septali*, in a Voyage he made a few Years ſince over ſome Mountains to *Genoa*, met with ſome Peaſants, who digging on the Sides of an Hill, had found and gathered very many *Cockle-Shells* of divers Kinds, which he wonder'd at, and therefore went to the very Place; where he was ſatisfied of the Truth of the Relation, finding great Store of different *Shells*, as the *Turbinets*, *Echini*, and ſome *Pearl-Shells*, whereof one had a fair *Pearl* in it.

Foſſile Shells in Italy; *By* S. Manfredus Septalius. n. 27. p. 493.

XXIX. Upon the Way of *Beziers* to *Narbonne*, in a Place pretty large, raiſed by Eſtimation above the *Level* of the *Sea*, (which is two Leagues diſtant from it) about 15 or 16 Fathoms, I ſaw Rocks which incloſed a good number of big *Oyſters petrified:* And upon the ſame Way above the Place, which is called *Nice*, at the higheſt Place of the Deſcent, very cragged, where the Rock is cut to make a Paſſage, is ſeen a Bed two Foot large of many *Cockle-Shells petrified*, heaped up, as ordinarily they are on the Sea-ſhore; which notes ſufficiently, that the Sea formerly covered this Place.

Foſſile Shells in France; *By* M. de Martel, *n.* 58. p. 1183.

XXX. We will eaſily believe (what I have read in *Steno's Prodromus*) that all along the Shores of the *Mediterranean Sea*, there may all Manner of *Sea-Shells* be found promiſcuouſly included in *Rocks* or *Earth*, and at good Diſtances too from the Sea. But for our *Engliſh* inland *Quarries*, I am apt to think, there is no ſuch Matter as *petrifying* of *Shells* in the Buſineſs: But that theſe *Cockle-like Stones* every where, as they are at preſent, *Lapides ſui Generis*, and never any Part of an *Animal*. It is moſt certain that our *Engliſh Quarry ſhells* (to continue that abuſive Name) have no Parts of a different Texture from the *Rock* or *Quarry* where they are taken, that is, that there is no ſuch Thing as *Shell* in theſe *Reſemblances of Shells*, but that *Iron-Stone Cockles* are all *Iron-ſtone*; *Lime* or *Marble*, all *Lime-ſtone* or *Marble*; *Sparre* or *Chriſtalline-Shells*, all *Sparre*, *&c.* and that they were never any Part of an *Animal*. My Reaſon is, that *Quarries* of different *Stone* yield us quite different Sorts of Species of *Shell*, not only one from another (as thoſe *Cockle-ſtone* of the *Iron-ſtone Quarries* of *Allderton* in *Yorkſhire*, differ from thoſe found in the *Lead-Mines* of the neighbouring Mountains, and both theſe from that *Cockle-Quarry* of *Wansford-Bridge* in *Northamptonſhire*, and all three from thoſe to be found in the *Quarries* about *Gunthrop*, and *Beavour Caſtle*, *&c.*) but, I dare boldly ſay, from any Thing in Nature beſides, that either the *Land* or *Salt*, or *freſh Water* doth yield us. 'Tis true, that I have pick'd out of that one *Quarry* of *Wansford* very Reſemblances of

Foſſile Shells in ſeveral Places of England; *By Dr.* M. Liſter, n. 76. p. 2282.

Murices, *Telinæ*, *Turbines*, *Cochleæ*, *&c.* and yet I am not convinced, when I particularly examin'd ſome of our *Engliſh Shores* for *Shells*, alſo the *freſh Waters* and the *Fields*, that I did ever meet with any one of thoſe *Species* of *Shells* any where elſe but in their reſpective *Quarries*; whence I conclude them *Lapides ſui Generis*, and that they were not caſt in any *Animal* Mold, whoſe Species or Race is yet to be found in being at this Day. I have two or three Sorts of our *Engliſh Cockle-ſtones* of different *Quarries*, nearly reſembling one another, and all of them very like a common Sort of Sea-ſhell; and yet there is enough in them ſpecifically to diſtinguiſh them, and hinder them from being ſampled by any Thing of the Spoils of the Sea or freſh Waters, or the Land-Snails.

Foſſile Shells in Kent, *By Dr.* Griff. Hatley. n. 255. p. 463.

XXXI. At *Hunton*, 5 Miles from *Maidſtone* in *Kent*, and about a Quarter of a Mile from the River *Medway*, after the Coping of a Piece of Ground was taken off, (which was of a Clay about 3 Foot deep) we came to a very good *Blue Marle*, which continued ſuch 3 Feet and ½ deep more; and then there appeared a hard Floor or Pavement compoſed of Shells, or Shell-like Stones, crouded cloſely together; the Interſtices whereof were filled up with the ſame *Marle*. This Layer (which runs as the Veins of Flints do in chalky *Earth*) was about an Inch deep, and ſeveral Yards over, and we could walk on it as on a Bench; under this Layer we came to *Marle* again. I cannot, upon Inquiry, find, that in the Memory of any Man thereabouts, any Floods from the River have reached ſo far as this Place.

The Stones (for I take them to be *Lapides ſui Generis*) are of that Sort which is call'd *Conclites*, and reſemble *Sea-Fiſh* of the *Teſtaceous* kind; moſt of them are *Turbinated*, or wreathed, the reſt are of the *Bivalvular* Sort, but I have not found any of them with *Valves* cloſed together, but ſingle.

The Bigneſs of the *Turbinated*, is from a *Vetch* to a Hazle-Nut, they are filled with a *Terra Lapidoſa*, like the *Marle*, and are of that Colour till you have waſhed and rubbed them, and then they appear of the Colour of *Bezoar*, and of the ſame Politure. After they have been boiled in Water, they are whitiſh, and leave a Chalkineſs upon your Fingers, which, when it is rubbed off, gives you a View of very fine black *Striæ*, thick ſet on the outſide. Theſe *Wreathed Stones* are all perfectly formed, they differ not in Figure one from another, but that ſome have their Sides a little depreſſed; upon a few of them there adhered a little Proportion of a glittering Mineral like Iron. In *Vinegar*, they made a ſtrong and a boiling *Efferveſcence*.

The *Bivalvular* are moſt of them no bigger than a Kidney Bean, ſome leſſer, a few as broad as the largeſt Sort of Beans, but the *Valve* much thinner than any of that kind, which had been the *Exuviæ* of an *Animal*; the gibbous Part of the *Valve* is ſmooth, and of the ſame Colour with that of the *Turbinated*. In a few there are ſome oblong Lineations bent circularly to the Commiſſure of the *Valve*: I have a Piece of ſuch an one by me, conſiſting of ſeveral *Lamellæ*, which hath this further obſervable in it, that the gibbous Part is of a moſt beautiful black ſhining Colour, and the inner Part of a ſhining Pearl-colour'd Subſtance.

Of this *Bivalvular* Sort, many of them ſeem to be *in fieri*, not as to their Shape, but as to their Hardneſs and Thickneſs, there being in ſome only the *prima Stamina*, and in others the ſeveral Steps and Progreſſes towards a perfect *Figuration*; which ſeems to me an unanſwerable Argument, for their never having been the *Spoils* of *Animals*. Some of theſe appeared in the Inner-ſide white, and it came off upon the Fingers like Chalk, and ſeemed as if a Depreſſion had been firſt made in the Bed of the Shape of a *Valve*, and then the Convex Side rubbed with Chalk or painted white,

Thoſe Pieces of this odd *Concretion*, which I keep by me (now the *Marle*, which is in the Interſtices, is grown hard) appear much like that coarſe Sort of *Marble-ſtone*, which is dug about *Pluckley* in the *Wild* of *Kent*. Which *Marble* ſeems to be a *Coagmentation* of ſuch *Shell-like Stones*, the *Marle* betwixt them having acquired firm Solidity and Hardneſs. With this *Stone* they make their Cauſeys in that Part of the Country; and they are apt to be worn into little Cavities, or Holes, where they have lain long expoſed to the Air; the Rains, in Length of Time, waſhing away the Portions of *Marle* (which is leſs hard than the reſt) from the Orifices and Interſtices of thoſe *Shell-like Stones*. I am much confirmed in this Opinion by a Piece of *Marble*, inlaid, as it were, with ſuch *Stones*, which was dug out of the Marle-Pit, at a little Diſtance from, and on the ſame Level with that at *Hunton*.

The imperfect, as well as the complete Formation of ſome of the *Bivalvular* kind (the *Valves* being only found ſingle, and both Sorts in a Ground never heretofore diſturbed) are no light Arguments for their being *Stones*. Perhaps the Salts of Plants or Animal Bodies, waſhed down with Rains, and lodged under Ground, may be there diſpoſed into ſuch like Figures, as well as above it.

Vid. Muſ. Reg. Societ. part 3. cap. 1.

Foſſile Shells in Berkſhire; *By Dr.* Ja. Brewer. n. 26. p. 464.

XXXII. Near *Reading* in *Berkſhire*, for many ſucceeding Generations, a continued Body of *Oyſter-ſhells* has been found through the whole Circumference of 5 or 6 Acres of Ground. The Foundation of theſe Shells is a hard rocky Chalk, and above this Chalk the *Oyſter-ſhells* lie in a Bed of green Sand upon a Level, as nigh as can poſſibly be judged; this *Stratum* of green Sand *Oyſter-ſhells* is (as I meaſured) nigh two Foot deep. Now immediately above this Layer, or *Stratum* of green Sand and *Shells*, is a Bed of a blueiſh Sort of Clay, very hard, brittle and rugged, they call it a pinny Clay, and this is of no uſe. This Bed, or Layer of Clay, I found to be nigh a Yard deep; and immediately above it is a *Stratum* of *Fuller's Earth*, which is nigh two Foot and a half deep; this *Earth* is often made uſe of by our Clothiers: And above this *Earth* is a Bed, or Layer, of a clear fine white Sand without the leaſt Mixture of any *Earth*, *Clay*, &c. which is nigh 7 Foot deep: Then immediately above this is a ſtiff red Clay, (which is the uppermoſt *Stratum*) of which we make our Tiles. The Depth of this cannot be conveniently taken, it being ſo high a Hill, on the Top of which hath been, and is dug up a little common *Earth* about 2 Foot deep.

I have, with a Mattock, dug out ſeveral whole *Oyſters* with both their *Valves* or *Shells* lying together, as *Oyſters* before opened: In their Cavity, there is got in ſome of the fore-mentioned green Sand. Theſe Shells are ſo very brittle, that in digging for them, one of the *Valves* will frequently drop from its Fellow; but 'tis plainly to be ſeen that they were united together, by placing the Shell that drops off to its *Fellow Valve*, which exactly correſponds: But I dug out ſeveral that were *Entire*; nay, ſome *double Oyſters* with all their *Valves* united.

Foſſile Shells and Fiſhes in Lincolnſhire; *By Mr.* Abr. de la Pryme, n. 266. p. 678.

XXXIII. In a *Quarry* at the Eaſt-end of *Broughton* in *Lincolnſhire*, they get a clayey Subſtance or *Earth*, that lies under the Stone in which are innumerable Fragments of the Shells of Shell-Fiſh of various Sorts, of *Pectinites*, *Echini*, *Conchites*, and others, with ſome Bits and Pieces of *Cornel*; and there are ſometimes found whole Shell-Fiſh, with their natural Shells on, in their natural Colours, moſt miſerably crack'd, bruiſed and broken, and ſome totally ſqueez'd flat by the great Weight of the *Earth* that yet lies, and that was caſt upon them in the *Noachian Deluge*.

There is another *Quarry* in the Field on the South Side of the Town, of a hard blue Stone, which was moſt certainly a pure fine blue Clay, in ſome *Antediluvian Lake*, in the Stones of moſt of which are innumerable *petrified* Shell-Fiſh of various Sorts, but ſo united to the Stone, that it is very difficult to get them whole out; and I have always found that they lie in the Superficies of the *Quarry*, within a Foot of the Top thereof, and few or none deeper therein. In many Places of the Surface of the *Quarry*, (which looks rugged and drifted, as Snow does after a Storm, and by which one may find what Quarter the Storm or Wind was then in) there are many Shell-Fiſh half in the Stone, half out. That Part which is within the *Quarry* is entire and whole, but a hard Stone; and that Part which is without, which the *petrcifik Effluviums* did not touch, is conſumed and gone, all but a little of the Edges which are plain Shell, and have all the *Radii* and *Striæ* on them, that the common Shells of thoſe Sorts of Fiſhes have.

All theſe Fiſhes have their Shells on, ſome of which Shells are exceeding thin, to what other ſome are. Sometimes the Shells of ſome of them are in their *petrifaction* ſo throughly united unto and incorporated with the Stone, that they are ſcarce viſible. Others in the ſame *Quarry* have a thick white Shell on them *petrified*, but not incorporated and turned into the Subſtance of the Bed in which they lie. As you get that Fiſh out, all the Shell ſticks ſo faſt to the Rock, that moſt commonly it is left behind, but ſometimes the Shell cleaves in two, one half of the Shell on both Sides of the Fiſh ſticks thereto, and the other half to both Sides of the Bed, but others come out by lying in the Air in froſty Nights, with the whole *natural Shell* on them, and the *Radii* or *Striæ* very exact. Other Fiſh there are here, that have a black ſmooth Shell on them, with ſeveral *Striæ*, but no *Radii*, very like, if not the ſame with the *Concha Nigra Rondel.*

I have alſo ſeen in this *Quarry* ſome *Shell-Fiſh* half open and fill'd with the Matter of the Bed in which they lie, and *petrify'd* with it. Others being in heaps together, I have found ſome of them broken, others bruiſed, and the Edges of one Fiſh thruſt into the Sides of another, ſome with the one

Shell thruſt half Way over the other, &c. and ſo *petrified* in the Bed together. Others in the ſame Bed have been ſo cloſe, that the Manner of the Bed could not inſinuate itſelf into them. Theſe, that are thus found, are ſome of them totally empty, others are filled with *Chriſtalline Fluors*, others I have ſeen half full of the ſaid blueiſh Clay of the Bed, and half full of the ſaid *Chriſtallizations*, which have ſtruck therein, from nothing but *ſubterraneous Heats* and *Effluviums*.

Amongſt theſe Fiſh in this *Quarry*, I have ſeen ſeveral great *Horſe-Muſcles*, ſuch as breed in *Freſh-Water-Rivers* and *Ponds*, which are exactly like the *Concha Longa Randel*, but are more thick, full, and pubble, than ours commonly are at this Day; which Greatneſs and Largeneſs proceeds from nothing but the Fertility and Fatneſs of the Bed on which they bred; and at this Day in an old Pond beyond *Broughton-Hall*, there are ſome of the largeſt of this Sort of *Shell-Fiſh* that ever I ſaw, as if this Soil agreed better to the breeding of this Sort of Fiſh than any elſe; juſt as the *Cornu Ammonis*, *Nautili*, and others breed beſt upon *Alum Soils*: And that is the Reaſon that they are found ſo much at *Whitby*, *Rochel*, *Lunenburgh*) *Rome*, and other Places, where are famous *Alum-Mines*. And if any one would find any of thoſe Sorts of Fiſhes (which ſome learned Men have ridiculouſly thought to be Species totally loſt) they ought in all probability to ſeek for them upon *Alum Soils* in the Sea, and there they would undoubtedly find them.

Others have an *Ouzey* Soil, a Sort of a confuſed Mixture of ſeveral Soils together, as Part of the Country about *Fordingham*, *Bramber*, *Aſhbee*, *Botſworth*, &c. ſeems to be; in the Fields and Stones of which Towns, is one particular Sort of Fiſh, which I knew not what *Genus* or *Species* to compare to, bending ſomewhat like a *Ram's-Horn*, and exactly creaſed like one on the out-ſide with an *Opuſculum* thereon, which the Fiſh opened and ſhut as it had Occaſion. The Bed whereon the ſaid *Shell-Fiſh* bred in the *Antediluvian Sea*, is not over a Foot thick (to the beſt of my Memory) in all which, but for the moſt Part in the Superficies thereof, are Millions of the ſaid Fiſh ſticking half within the Stone, half without; which *Shell-Fiſh* having a moſt durable Shell, that Part which ſticks out of the Stone, is conſum'd, as in the *Shell-Fiſh* of *Broughton*, but remains whole and entire. And yet I have ſeen and found whole Lumps of them, that by ſome huge Weight caſt or fallen upon them, in the *Noachian Deluge*, have been miſerably broken and ſhattered in Pieces, and ſo *petrified* in the Bed as they lay.

In the Pariſh of *Broughton* aforeſaid, in the looſe *Earth* above the aforeſaid blue *Quarry*, and elſewhere, I have found in a whitiſh Stone, the *Echini Galeati Puncticulati Lluydii*, the *Turbinites Major. Lluydii. Tab.* 7. *N.* 341. the *Cochlites Lævis Vulgatior. Lluydii T.* 7. *N.* 322; in blue Stone, the *Concha altera Longa Rondeletii*, exactly agreeing to the Picture and Bigneſs thereof in *Geſner de Piſcibus*, p. 231. only the *Neb* is much longer: I have found alſo Multitudes of *Belemnites*, great and little, perforated and flat at the Root, by which they grew in the *Antediluvian Sea*, unto ſome of which I have found little Shell-Fiſh ſticking.

There have been many Conteſts and Diſputes amongſt the Learned concerning theſe Appearances; but my Notion of them is, that the *Antediluvian World* had an external Sea as well as Land, and Mountains, Hills, Rivers, and fruitful Fields and Plants; that it was about the Bigneſs that our Earth is at preſent of, and that when God had a mind, for the Wickedneſs of the Inhabitants that dwelt thereon, to deſtroy the ſame by Water, he broke the Foundations and ſubterraneous Caverns and Pillars thereof with moſt dreadful *Earthquakes*, and cauſed the ſame to be for the moſt Part, if not wholly, *abſorbed* and ſwallowed up, and covered by the Seas that we now have; and that this Earth of ours riſe then out of the Bottom of the *Antediluvian Sea* in its Room: juſt as many Iſlands are ſwallowed up, and others thruſt up in their ſtead.

From this happy Syſtem of the *Deluge*, which is the moſt concordant to the Scriptures of all others, all thoſe Things are eaſily ſolved that were hard and difficult before. It is no longer a Wonder that Shells, and Shell-Fiſh, and the Bones of other Fiſhes and Four-footed Creatures, and Fruits, *&c.* are found (as they commonly are) in Beds and *Quarries*, in Hills and Mountains, and in the Bowels of the Earth; for here they bred in the *Antediluvian Sea*, thither they were elevated with the Hills and Mountains in the Time of the *Deluge*, there they fell into, were abſorbed and buried in Chaſms, and Holes, and Clefts, that would neceſſarily happen in the thruſting up of the Earth, and are found in the Soil that was flung and carried with wonderful Violence and Confuſion from one Place to another, by the Working of the Waters, and the Ferment and Hurry that they were put into.

And as all Countries were thus raiſed out of the Bottom of the *Antediluvian Sea* and *Lakes*, ſo that Part of the Country, about *Broughton* aforeſaid, appears manifeſtly, in the *Antediluvian World*, to have been the Bottom of ſome *Freſh-water Lake*, becauſe that thoſe are Freſh-water Shell-Fiſh which are found there; and the Bed, upon which they bred, was a fine blue Clay, which is the Colour of the Stone to this Day: Which Bed being *elevated* and lifted up (and daſhed over with other Earth in the Workings of the Waters, and the great Hurry and Confuſion that then happened) the ſaid Bed, by the Power of the *ſubterraneous elevating Heats*, *Steams*, and *Effluviums*, was turned by Degrees into Stone, with all the Fiſhes therein.

I have before told you, that ſome of the Shell-Fiſh, in the ſame Bed, are not only full of the Matter of the Bed, but of *Flours*, tho' ſuch are not very common. Some might wonder, ſeeing that the Shells are cloſed, that the Matter of the Bed could inſinuate itſelf into them; but that is nothing but what is common in like Caſes: For I have frequently ſeen, in the Bottoms of Ponds and Rivers, where ſuch Shell-Fiſh in Plenty are, that when the Fiſh is dead and conſumed, and the Shell in the Mud, with the Edges as cloſe as if the Fiſh was alive, that nevertheleſs the Mud or Clay will, by Degrees, inſinuate and fill the ſame. And now if the Bottom of any one of the ſaid Rivers or Ponds was raiſed by *Earthquakes*, and turned into Stone by *Petrifick Effluviums*, they would exactly be found as theſe are.

That many *Shell-Fiſh* ſuffered ſuch wonderful great Violence and Force in the ſaid great Flood, inſomuch as to be cruſh'd, and bruis'd, and ſqueez'd flat, as ſome of thoſe manifeſtly are; is likewiſe nothing ſtrange or wonderful, if we do but conſider the great Pieces of riſing Rocks, and Hills, and Mountains, that muſt needs roll down, and fall in ſuch a general Hurry and Confuſion as that muſt needs have been in the *Quarry*, at the Eaſt End of this Town of *Broughton*: where Fragments of innumerable Shells are found, and ſome *Shell-Fiſh* ſqueez'd flat, all which are natural, and not petrify'd. There was in the *Deluge* flung upon the ſame a huge Bed of a mix'd confuſed Subſtance, now turn'd into a whitiſh ſoft canker'd Stone, and upon that were caſt vaſt Quantities of *Earth*, all which weigh'd and preſſed the tender Shells ſo much, that they ſqueezed ſome flat, and broke others to Pieces, as we find them to be at this Day.

I have a hard Stone, Part of the aforeſaid blue *Quarry*, with little Bits of *Wood-Coals* therein, and whole *Leaves of Vaccinia*, or *Whortle-Berries*, ſuch as grow upon Heaths very exact: And Mr. *Lluyd* and others have given us ſeveral large Accounts of whole *Leaves* and *Plants* found in Stones and Rocks, and deep in the Bowels of the *Earth*, ſome folded, ſome plain, ſome imperfect; all which is very eaſily ſolvable, having in that general Confuſion and Hurry been ſeized upon and embody'd in Lumps of Clay and other Matters, and others catched and intercepted in Rolling Beds of *Earth*, as they tumbled down from riſing Hills and Mountains, and ſo lodg'd deep in Chaſms of the Ground and petrify'd, and ſo preſerv'd unto this Day.

Gloſſopetræ, *By Dr.* Liſter. n. 110. p. 223.

XXXIV. I have had out of the Iſle of *Sheppey* in the River of *Thames*, very *Sharks Teeth* dug up there, which could not be ſaid to be petrified. They were ſomewhat gilded with a *Vitriolick* Tarniſh at our firſt receiving them; but they were white, and in a ſhort Time came to their natural Colour.

In the *Stone Quarries* in *Hinderskelf-Park* near *Malton* in *Yorkſhire*, I took out of the Rock myſelf a fair *Gloſſopetra* with three Points of a black Liver-Colour, and ſmooth; its Edges are not *Serrate*; its Baſis is (like the *true Teeth*) of a rugged Subſtance; it is carved round the Baſis with Imboſſed Work: It hath certain eminent Ridges, or Lines like Rays, drawn from the Baſis to each Point.

The Foſſile Tongue *of a* Paſtinaca Marina; *By Dr.* Hans Sloane. n. 232. p. 674.

XXXV. Dr. *Tancred Robinſon* received lately from *Maryland* a conſiderable Number of *Foſſile Bones* and *Shells* of ſeveral Sorts. Some of them had received little Alteration in the *Earth*, others more, and ſome were ſo changed as to be ſtony: But all of them retained their ancient Shape. One of theſe *Foſſiles* I compared with the Tongue of a Fiſh I had obſerved in *Jamaica*, and with another of the ſame Tongues in Pieces, which I ſaw in Mr. *Charleton*'s moſt uſeful and admirable Collection of *natural Curioſities*, and found a perfect Agreement. Another of theſe *Foſſiles* I ſuppoſe is the upper *Mandible*, or Palate of this Fiſh, which is oppoſite to, or anſwers this Tongue: The Agreement of this in all Parts with the Tongue, making it very likely to belong, if not to this ſame, yet to this kind of Fiſh.

A Part of one of the Joints of this Tongue was dug up in *England*, and given to Mr. *Charleton*, by Mr. *Lluyd* of *Oxford*, by the Name of *Siliquaſtrum Subnigrum Pectinatum Maximum*.

Fig. 87, 88. Dr. *Robinſon* thinks the *Foſſile Palate* or *Mandible*, *Fig.* 87. and 88. may be of the ſame kind with that taken notice of by *Lachmund*, in this Book *de Lapidibus*, *p.* 17. where 'tis call'd *Pentacrinous*.

Fig. 75. *Fig.* 75. Is the whole Tongue of a *Flat-Fiſh* a-kin to a *Thornback*, which I call *Paſtinaca*, *Marina*, *Levis*, *Livida*, *Albis Maculis notata*. It is made up of many Bones (about 19 in this) which are each of them crooked, their two Sides making an obtuſe Angle, ſuch as the Sides of the *Under-Mandible* of a *Man* does: The uppermoſt Sides of theſe ſeveral Bones have *Furrows* and Pieces ſtanding together after the Manner of the Teeth of a Short ſmall-toothed Comb, the extant Ends of which anſwer the like Parts in the Bones of the upper Jaw of this Fiſh, between which and this Tongue the Food of this Fiſh is cut, torn, or ground to Pieces.

Fig. 76. *Fig.* 76. Is the underſide of the ſame divided into ſeveral Pieces alſo, but having no *Furrows* or *Teeth*, as thoſe of the upper Side have.

Fig. 77, 78, 79, 80. *Fig.* 77, 78, 79, 80. Shew the Joints or Pieces of the ſame Tongue, ſeparated in ſeveral Poſitions of their upper and under Sides, to ſhew the perfect Agreement between the Pieces of the Tongue of the Fiſh taken lately from it, and thoſe taken out of the *Earth*, which are figur'd in the like Poſitions. *Fig.* 81, 82, 83, 84, 85, 86.

Fig. 81, 82, 83, 84, 85, 86.

Fig. 87, 88. *Fig.* 87, 88. Are the upper and under Sides of what, I ſuppoſe, is the *Upper-Mandible* or *Palate* of this *Fiſh*, which is oppoſite to, and anſwers this Tongue.

Mr. *Willoughby* and Mr. *Ray* call this Fiſh *Nari-Nari*; and I am apt to believe the Anonymous *Portugueſe*, whoſe Deſcription of *Brazil* is publiſhed in *Purchas*, *Lib.* 7. *Cap.* 1. *p.* 1313. means this, when he ſays there were Rays, *having in their Mouth two* Bones *breaking* Wilks *with them*.

Horns *of* American Deer *found under Ground in* Ireland; *by Dr.* Tho. Molineux, n. 227. p. 489.

XXXVI. I had lately an Opportunity of particularly examining a compleat Head, with both its Horns entirely perfect, not long ſince dug up in *Ireland*, and given to my Brother *Will. Molineux*, as a Natural Curioſity, by Mr. *Henry Oſton*, that lives at a Place call'd *Dardiſtown*, in the County of *Meath*, about 2 Miles from *Drogheda*. This is the *third Head* which hath been found by caſual trenching in his *Orchard*; they were all dug up within the Compaſs of an Acre of Land, and lay about 4 or 5 Foot *under ground*, in a Sort of a *boggy Soil*. The firſt Pitch was of *Earth*, the next 2 or 3 of *Turf*, and then followed a Sort of *white Marle*, whereby they were found.

I took the *Dimenſions* of this *Head* carefully, as follows, from the extreme Tip of the right *Horn*, to the extreme Tip of the left *A B*, was 10 Foot 10 Inches; from the Tip of the right *Horn*, to the Root where it was faſtened to the *Head C D*, 5 *Feet* 2 *Inches*; from the Tip of the higheſt Branch (meaſuring one of the *Horns* tranſverſe, or directly acroſs the *Palm*) to the Tip of the loweſt Branch *G F*, 3 Foot 7½ Inches. The Length of one of the *Palms*, within the Branches *G H*, 2 Feet 6 Inches; the Breadth of the ſame Palm, ſtill within the Branches *I K*, 1 Foot 10½ Inches; the Branches that ſhot forth round the Edge of each *Palm*, were 9 in Number, beſides the *Brow-Antlers*, of which the right *Antler D L*, was 1 Foot 2 Inches in Length, the other was much ſhorter; the *Beam* of each *Horn M*, at ſome diſtance from the *Head*, was about 8 Inches in Circumference; at the Root where it was faſtened to the *Head*, about 11 Inches in Circumference; the Length of the Head from the back of the Skull to the tip of the Noſe, or rather the Extremity of the upper Jaw-bone *N O*, 2 Feet; the Breadth of the Skull where largeſt *P Q*, was a Foot. There were 2 *Holes* near the Roots of the *Horns* that look'd like *Eyes*, but were indeed large open Paſſages, near an Inch in Diameter, in the *Forehead-bone*, to give way to great Blood-Veſſels, that here iſſue forth from the Head, and paſs between the Surface of the Horn, and the ſmooth hairy Skin that covers them whilſt they are growing (which is commonly called the *Velvet*) to ſupply the *Horns* with ſufficient Nouriſhment, while they are ſoft, and till they arrive at their full Magnitude, ſo as to become perfectly hard and ſolid.

Theſe Veſſels, by reaſon of their Largeneſs and great Turgency of the Humour in them, whilſt the Horn is ſprouting and pliant, make deep and conſpicuous Furrows all along the outſide of it where they paſs, which may plainly be ſeen after the Horn is bare and come to its full Growth, at which time all theſe Veins and Arteries, with the outward *Velvet* Skin, drying by the Courſe of Nature, ſhrivel up and ſeparate from the *Horn*, and the Beaſt affects tearing them off in great Stripes againſt the Boughs of Trees, expoſing his Horns naked when they are thoroughly hardened, without any covering at all.

Such then were the vaſt *Dimenſions*, according to which the lofty Fabrick of the *Head* and *Horns* of this ſtately Creature was built: And yet it is not to be queſtioned but theſe ſpacious *Horns* as large as they were, like others of the *Deer-kind*, were naturally caſt every Year, and grew again to their full Size in about the ſpace of 4 Months. For all Species of *Deer* yet known certainly drop their *Horns* Yearly, which I conceive to proceed from the ſame Cauſe, that *Trees* annually caſt their ripe Fruit, or let fall their withering *Leaves* in *Autumn*; that is, becauſe the nouriſhing *Juice*, ſay it is Sap or *Blood*, is ſtopped and flows no longer, either on the account it is now deficient, being all ſpent, or that the cavous Paſſages which convey it, dry up and cool, ſo as the *Part* having no longer any *Communication* with, muſt of neceſſity by degrees ſever from the *Whole*; but with this Difference, that *Horns* by reaſon of their hard, material, and ſtrong Compoſition, ſtick faſt to the *Head* by their Root 7 or 8 Months after all their Nouriſhment perfectly retires, whereas *Leaves* and *Fruit*, conſiſting of a much more tender Subſtance, and a finer Texture of Parts, drop ſooner from their native Beds where they grew, when once the Supply of uſual Nouriſhment is ſtopt. This Analogy that *Nature* obſerves in caſting the *Horns* of Beaſts, and dropping the Fruit of Trees, will appear much more evident to any one that will obſerve the End of a Stalk, from which a ripe *Orange*, or any large Fruit, has been lately ſever'd, and the But-end of a caſt Horn, where it is faſten'd to the *Os-frontis*; for by comparing them together, he ſhall find ſo great a Congruity in the Shape of both, that 'twill be apparent, Nature works according to the ſame *Mechaniſm* in one as in the other.

Such another *Head*, with both the Horns entire, was found ſome Years ſince by one Mr. *Van Delure*, in the County of *Clare*, buried 10 Feet under Ground in a ſort of *Marle*, and was preſented by him to the late D. of *Ormond*. In the Year 1691, Major *Folliot* told me, that digging for *Marle* near Town *Ballymackward* near *Ballyſhannon* in the County of *Fermanagh*, he found, buried 10 Feet under plain ſolid Ground, a pair of theſe ſort of Horns. In the Year 1684, there were two of theſe *Heads* dug up near *Turvy*, within 8 Miles of *Dublin*.

Not long ſince a *Head* of this kind, with its *Horns*, was found near *Portumny*, ſeated on the River *Shannon*, in the County of *Gallaway*. Such a *Forehead* with two extraordinary *Beams* of theſe kind of Horns, may be now ſeen faſtened againſt one ſide of the *Common-Hall* of his Grace *Michael* Lord Archbiſhop of *Armagh*'s Houſe here in *Dublin*; they are both imperfect, and want their *Palms*, yet by the vaſt Thickneſs and Length of the *Beams*, I judge, when entire, they much exceed the Size of thoſe I have given the Dimenſions of above. The *Primate* told me, they were found ſomewhere in the Province of *Ulſter*.

To theſe I might add many more Inſtances of the like; as thoſe found by the late Lord *Mountjoy*, near his Houſe at *Newton-Stewart*, and thoſe kept at *Stockallen* in the County of *Meath*; for to my Knowledge, within leſs than 20 Years, above 20, I might ſafely ſay, 30 Pair of theſe ſort of Horns have been dug up in ſeveral Places of this County, all found by accident; and we may well ſuppoſe vaſt Numbers ſtill remain undiſcovered: But theſe may ſuffice plainly to ſhew, this Creature was formerly common with us in *Ireland*, and an *indigenous Animal*, not peculiar to any Territory or Province, but univerſally met with in all Parts of the Kingdom. We may alſo reaſonably gather, that they were a *gregarious Animal*, as the *Naturaliſts* call them; or ſuch a ſort of Creature as affect naturally keeping together in *Herds*; as we ſee the *Fallow Deer* with us, and as 'tis reported of the *Elches* in *Sweden*, and the *Rain Deer* in the Northern Countries of *Europe*; for otherwiſe we cannot eaſily fancy it ſhould happen, that three of their Heads ſhould be all found within the narrow Compaſs of one Acre of Ground.

That theſe and ſeveral others, and indeed I think I may ſay all that I have been particularly inform'd of, though dug up in far diſtant Places of *Ireland*, ſhould be conſtantly found buried in a ſort of *Marle*, ſeems to me to intimate, as if *Marle* was only a Soil that had been formerly the outward Surface of the Earth, but in Proceſs of Time, being covered by Degrees with many Layers of adventitious Earth, has by laying under Ground a certain Number of Ages acquired a peculiar Texture, Conſiſtence, Richneſs or Maturity, that gives it the Name of *Marle*. For of Neceſſity we muſt allow the Place where theſe *Heads* are now found, was certainly once the external Superfice of the Ground, otherwiſe it is hardly poſſible to ſuppoſe how they ſhould come there.

And that they ſhould be ſo deep buried as we at preſent find them, appears to have happened by their accidentally falling where it was ſoft low Ground; ſo that the Horns by their own conſiderable Gravity might eaſily make a Bed where they ſettled in the yielding Earth, and in a very long courſe of Time, the higher Lands being by Degrees diſſolved by repeated Rains, and waſhed and brought down by Floods, covered thoſe Places that were ſituated lower, with many Layers of Earth: For all high Grounds and Hills, unleſs they conſiſt of a Rock, by this means naturally loſe a little every Year of their Height, and ſometimes ſenſibly become lower even in one Age; of which we may ſee ſeveral ſatisfactory Inſtances related by Dr. *Plot* in his *Natural Hiſtory of Staffordſhire*, *Chap.* 3. *Page* 113. As for all ſuch Heads that might chance to fall on high or hard Grounds, where they could not poſſibly be covered or defended, theſe muſt of Neceſſity rot, periſh, and be deſtroyed by the Weather.

By what means this kind of Animal, formerly ſo common and numerous in this Country, ſhould now become utterly loſt and extinct, deſerves our Conſideration.

Some have been apt to imagine this, like all other Animals, might have been deſtroyed from off the Face of this Country, by the Deluge in the Time of *Noah*: But if we conſider what a fragil, ſlight, and porous Subſtance theſe and the Horns of all *Deer* are, we cannot well ſuppoſe they could by any means be preſerved entire and uncorrupt from that *Flood*, now above 4000 Years ſince; and I have by me ſome of the Teeth, and one of the lower Jaw-bones of this Creature ſo perfect, ſolid, ponderous and freſh, that no one that ſees them can poſſibly ſuſpect they could have been in Nature ſo many Ages paſt: And therefore it ſeems more likely to me, this kind of Animal might become extinct here, from a certain ill Conſtitution of Air in ſome of the paſt Seaſons long ſince the Flood, which might occaſion an *Epidemick Diſtemper*, if we may ſo call it, or *Peſtilential Murrain*, peculiarly to affect this Sort of Creature, ſo as to deſtroy at once great Numbers of them, if not quite ruin the Species. For this Iſland may very well be thought neither a Country nor Climate ſo truly proper and natural to this Animal as to be perfectly agreeable to its Temper, ſince for aught I can yet learn, it neither is, nor ever has been an Inhabitant of any of the adjacent Kingdoms round about us. And beſides the three Heads above-mentioned, found ſo cloſe to one another in the County of *Meath*, and the two near

Turvy, ſeems not a little to countenance this Opinion, as if theſe Animals died together in Numbers, as they had lived together in *Herds*. To this Purpoſe, *Scheffer* in his *Laponia* ſpeaking of the *Rain Deer*, an Animal that agrees in Kind with ours, tho' it be a quite different Sort of *Deer*, ſays, that whole Herds of them are often deſtroyed by a raging Diſtemper like a Plague, common among them; and that ſometimes they all die, ſo that the *Laplander* is forced to ſupply himſelf with new.

'Tis probable, however, that ſome of them might have eſcaped this common Calamity; but theſe being few in Number, I imagine as the Country became peopled, and thickly inhabited, they were ſoon deſtroyed and killed like other *Veniſon*, as well for the Sake of Food as Maſtery and Diverſion. And certainly theſe ſavage Ages of the World would not have ſpared the reſt of the *Deer Kind*, *Stags* and *Hinds*, *Bucks* and *Does*, which we ſtill have, but that theſe, being of a much ſmaller Size, could ſhelter and conceal themſelves eaſier under the Covert of Woods and Mountains, ſo as to eſcape utter Deſtruction.

And here I cannot but obſerve, that the *Red Deer*, in theſe our Days, is much more rare with us in *Ireland*, than it has been formerly, even in the Memory of Man: And tho' I take it to be a Creature, naturally more peculiar to this Country than to *England*, yet unleſs there be ſome Care taken to preſerve it, I believe in Proceſs of Time, this Kind may be loſt alſo, like the other Sort we are now ſpeaking of.

It remains that we enquire what *Species of Animals* it was, to which theſe ſtately *Horns* formerly belonged. I know it is an Opinion generally receiv'd, that they belonged to the *Alche*, *Elche*, or *Elende*, and therefore are vulgarly called *Elche's Horns*: But I have ſeen a Pair of *genuine Elche's Horns* brought out of *Swedeland*, and they differed extremely both in *Figure* and *Size*, from theſe we have now deſcribed. They were abundantly ſmaller, and quite of another *Shape* and *Make*, not *palmed*, or broad at the End fartheſt from the *Head*, as ours; but on the contrary, broader towards the *Head*, and growing ſtill narrower towards the Tips End, the ſmaller *Branches* not iſſuing forth from both *Edges* of the *Horns* as in ours, but growing along the upper Edge only, whilſt the other *Verge* of the *Horn* was wholly plain without any *Branches* at all. The faithful *Geſner* ſpeaking of the *Size* of them, ſays, *Cornua ſingula Libras circiter duodecim appendunt, Longitudine fere duorum Pedum*: Whereas the *Horns* we find here in *Ireland* are near thrice that Length, and above double that Weight, tho' dried, and much lighter from their being ſo long kept. Moreover the *Elche*, as deſcribed by *Apollonius Menabenus*, who had ſeen many of them, is no larger than a middling Horſe. And Mr. *Duncombe* told me, when he was Envoy in *Sweden*, he had ſeen there above 100 *Elches* together in a Herd, and none of them above five Feet high. And if ſo, we cannot imagine a Creature of that ſmall Size could poſſibly ſupport ſo large and heavy a Head, with ſo wide and ſpreading a Pair of *Horns* as theſe we are ſpeaking of; conſidering that exact *Symmetry*, and due Proportion of Parts, Nature obſerves in the Formation of all the larger and perfecter Sort of Animals.

De Quadrup. c. 1.

But the Deſcription of that lofty horned Beaſt in the *Weſt-Indies*, called a *Mooſe*, much better agrees with our *Iriſh* Animal than that of the *Elcbe* does. This Animal I find deſcribed by Mr. *John Joſſelyn*, among his *New-England* Rarities, in theſe Words: *The* Mooſe-Deer, *common in theſe Parts, is a very goodly Creature, ſome of them twelve Feet high*, (*in Height*, ſays another Author more particularly, *from the Toe of the Fore-Foot to the Pitch of the Shoulders* 12 *Feet*; *in its full Growth much bigger than an* Ox) *with exceeding fair* Horns *with broad* Palms, *ſome of them two Fathoms or twelve Feet from the* Tip *of one* Horn *to that of the other*. This is 14 Inches wider than ours was. Another thus deſcribes the manner of the *Indians* Hunting this Creature: *They commonly hunt the* Mooſe, *which is a kind of* Deer, *in the Winter, and run him down ſometimes in half, otherwhile a whole Day, when the Ground is covered with Snow, which uſually lies here four Feet deep*; *the Beaſt, very heavy, ſinks every Step as he runs, breaking down Trees as big as a* Man's *Thigh with his* Horns; *at length they get up with it, and darting their Lances, wound it ſo, that the Creature walks heavily on, till tired and ſpent with Loſs of Blood, it ſinks and falls like a ruined Building, making the Earth ſhake under it.* So that we have not the leaſt Reaſon to queſtion but theſe vaſtly large *Iriſh Deer* and the *American Mooſe*, were certainly one and the ſame Sort of Animal, being all of the *Deer Kind*, carrying the ſame Sort of palmed Horns, which are of the ſame Size and Largeneſs as well as Figure; and the Bulk of their Bodies correſponding exactly in proportion to the wide ſpreading of their *Horns*. So that we may ſecurely aſſert, that *Mooſes* formerly were as frequent in this Country, as they have them ſtill in the Northern Parts of the *Weſt-Indies*, *New-England*, *Virginia*, *Maryland*, and *Canada*, or *New France*.

And leſt we may think this Animal peculiar to the *Continent*, and not to be found in Iſlands, a remarkable Paſſage in *John de Laet*'s Deſcription of the *Weſt-Indies* clearly ſhews the contrary: *There are found*, ſays he, *great Numbers of theſe Animals in an Iſland near the* Continent, *called by the* Engliſh, Mount *Manſell*. This may give us reaſonable Grounds to believe, that as this Iſland of Mount *Manſell* muſt of neceſſity have had ſome Communication with the Main-Land of *America*, to have been thus plentifully ſtock'd with this Sort of Beaſts; ſo *Ireland*, for the ſame Reaſon, muſt in the many paſt Ages, long before the late Diſcovery of that *New World*, have had ſome Sort of *Intercourſe* with it likewiſe, (though 'tis not eaſy, I acknowledge, for us at preſent, to explain how) for otherwiſe I do not ſee how we can conceive this Country ſhould be ſupplied with this Creature, that, for ought I can yet hear, is not to be found in all our Neighbourhood round about us; nay, perhaps in any other Part of *Europe*, *Aſia*, or *Africa*: And then 'tis certain, as *Ireland* is the laſt or moſt Weſtern Part of the *Old World*, ſo 'tis neareſt of any Country to the moſt Eaſtern Parts of the *New*; *Canada*, *New-England*, *Virginia*, &c. the great Tract of Land, and the only one I yet know, remarkable for Plenty of the *Mooſe Deer*.

XXXVII. *Tonna*, a conſiderable Diſtrict of *Thuringen*, near to *Erfurt*, was formerly ſubject to the Family of *Glichen*, which becoming extinct, it had afterwards

An Elephant found under Ground near Erfurt *in* Germany: *By* Will. Ern. Tentzelius. n. 234. p. 757.

afterwards ſeveral Maſters, and at laſt was annexed to the Dukedom of *Saxe-Gotha*, being claimed, in the Year 1677, by Prince *Frederick*, Father of the preſent Prince of that Name, as his hereditary Right. It has two ſmall Towns or Villages of the ſame Name, one of which is called *Burg-Tonna*, or *Caſtle Tonna*; and the other *Grafen Tonna*, or *Earl's Tonna*. Which of the two is moſt ancient I cannot take upon me to determine; but it appears from the Annals of the Country that there was an ancient Town, called *Donnaba*, in the Charter of *Otton* the Great, which was given in the Year of *Chriſt* 973, and in my Opinion the Town there meant was *Burg-Tonna*. Very near this Town there is a ſandy Mountain or Hill, at the Bottom of which there is Plenty of a very pure white Sand, which they uſed to carry to great Diſtances for the Uſe of various Artificers. As they were digging here in *December*, in the Year 1695, they found ſome prodigious large Bones, which ſeemed to belong to the hind Feet of ſome Quadruped, one of them weighing nineteen Pounds. Then they found a round Head of a Bone, larger than a Man's Skull, fixed in a Socket, weighing nine Pounds; and then a larger Bone, like that of the Thigh, weighing thirty-two Pounds. Searching farther in the cold Weather, which is common in the Beginning of the Year, they hit upon the back Bone, with the Ribs adhering to it, and digging ſtill deeper they found two more round Bones larger than the former one, together with the Bones next to them, *viz.* thoſe of the fore Feet; then the Shoulder Blade, four Feet long, and two Spans and a half broad. Soon after they came to the Vertebræ of the Neck, together with the Dentata; and laſt of all appeared the Head of a monſtrous Size, with four of the Grinders, each of which weighed twelve Pounds, and the two largeſt Teeth or Horns, two Spans and a half thick, and eight Feet long, ſtanding out from the Head. In order that the Head might be better ſeen, a Hole was dug in the Hill of twelve Cubits, or four and twenty Feet deep; which being done, his Serene Highneſs came himſelf, and I had the Honour to be one of thoſe who attended him by his Order, where there was a great Concourſe of Spectators, and every Body admired the prodigious Size of the Head and Teeth; but we were very ſorry to find that the Head and all the other Bones and the Teeth, except thoſe of the Jaws, which were almoſt entire, were become ſo brittle, carious, and ſo thin with lying, that we could not find one of them that was quite ſound, but they were all broke to Pieces.

When the Report of theſe Bones was firſt ſpread abroad, the common Opinion was, that they were the Bones of a Giant, which both I and other conſiderate Perſons laughed at, and as ſoon as the Head appeared that Opinion vaniſhed. But afterwards there were two other Opinions ſtarted, one of which was, that theſe Bones muſt be the Skeleton of an Elephant, very much decayed or corrupted with Time; and the other, that it was rather a Foſſil Unicorn, as they call it, or a Mineral mimicking an animal Production. I imagine the former to be the moſt probable of the two. For by comparing this Skeleton with that of the Elephant given to the Univerſity of *Dublin* in *Ireland*, in the Year 1681, by *A. Moulins*, it appears that theſe two agree in every Circumſtance. This, eſpecially, is to be remarked, that, as *Moulins* ſays, in the Cranium of the Elephant there are a great Number of Cells, for the moſt part triangular, lined with Membranes in which there is a curious Diſpoſition of the Blood Veſſels, which are very numerous; and that theſe Cells are compoſed of thin bony Plates. Now not only the Perſons, who digged up this Cranium at *Tonna*, ſay, that they found it not only concave and perforated like an Ant's Hillock, but the ſame thing appears very plain from the Fragments of it, where thoſe Cells made of bony Plates, and the greateſt Part of them triangular, are very conſpicuous, going ſometimes obliquely, and ſometimes directly croſs the Skull. The Membranes, together with their dried Blood Veſſels, we found glewed very firmly to the Cells tinged with a yellow reddiſh Colour, and happening to try them with a Knife, they fell off in Pieces, taking away with them that Colour, and thereby expoſing the white Bones to view. Beſides that Foramen, which *Moulins* obſerved in the Cranium for the Paſſage of the Medulla Oblongata, that ſingular Cavity for lodging the Brain appears likewiſe in ours; and the Length of the Cranium, which he meaſured from one Extremity to the other, to be twenty Inches and a Quarter, in ours is ſaid to have been three Feet and a half, which being forty-two Inches, makes us conjecture, that this Elephant muſt at leaſt have been twice as large as the one in *Ireland*, which will appear ſtill more plain from what follows. Concerning the external Shape of the Skull of the Elephant, another *Engliſhman, viz. John Ray*, in his Synopſis of Quadrupeds, obſerves, that its poſterior Part is divided into two very large Sinuſſes or Lobes, ſo as to reſemble a Man's Hips; nor is there any Cavity to be obſerved jetting out for receiving the Cerebellum, as in many other Quadrupeds, but it rather reſembles the Figure of the human Skull. And I call all thoſe to witneſs, who ſaw the Head lying in the Sand, whether this Deſcription of it is not exact. The longeſt Teeth or Horns, beſides their Thickneſs and Length above-mentioned, at the ſame time diſcovered that natural Smoothneſs, yellowiſh Colour intermixed here and there with blackiſh Spots, Crookedneſs, and Striæ, which are common to the Teeth and Horns of no other Animals. Nay, what is extremely remarkable, there remains ſtill the Print of the right Tooth, which appears evidently to have been filed, according as *Pliny* remarks, "*that Elephants ſharpen, and file their Horns upon* "*a Tree*". Neither muſt I forget to mention, amongſt others, who came in Shoals from all Quarters to view this Sight, a certain Merchant, who had lived many Years in *India*, and according to the Rules of the *Indians*, which he ſaid he knew very well, he judged from the Teeth or Horns of this Elephant, that it muſt have lived upwards of two hundred Years. Upon this Subject *Aldrovandus* brings in the Teſtimony of *Aloyſius Cadamaſtus*, who ſays he once ſaw an Elephant killed of a very moderate Size, the Length of whoſe Teeth exceeded three Palms or Spans; they ſtood up two Spans above the Gum, and the third ſunk into the Gum, ſo as to be hid by it, like the Roots of other Teeth; and ſince the Age of theſe Animals is known by their Teeth, this muſt have been very young in Compariſon of others, whoſe Teeth are ſo large as to ſupply the Place of Poſts and Pales for Hedges, as *Pliny* ſays; and as the *Blacks* relate, in ſome Elephants, they grow to ſuch a Length as to

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exceed twelve Spans. This laſt makes very much to our Purpoſe; for *Cadamuſtus* means the greater Palm, which we otherwiſe call a Span; twelve Palms then make eight Feet, which is the Length of the Teeth at *Tonna*. That which *Harduin*, the laſt Commentator on *Pliny*, mentions he ſaw at *Dieppe*, comes pretty nigh to this, being ſeven Feet long, and weighing upwards of a hundred Weight. Beſides *Gellius* aſſerts, that they frequently grow to the Length of ten Feet. Nor is there any thing ſurprizing in the Weight of the Teeth at *Tonna* being upwards of a hundred Pounds, ſeeing there are found ſome that weigh a hundred and forty Pounds, ſuch as a Friend of mine told me he ſaw in *Holland*; or one hundred and fifty, or two hundred *Roman* Weight of twelve Ounces, as *Eraſmus* relates of *Franciſcus*; or a hundred and ſixty, ſuch as *Terzagus* deſcribes in the *Septalian Muſæum*. *Vertomannus* likewiſe ſaw two in *Sumatra*, which together weighed three hundred and thirty ſix Pounds. It is ſufficient for me to mention the undoubted Teſtimony of a certain Ducal Miniſter, who lived ſome Years in *Sumatra*, and other Parts of *India*, and affirms, that he has ſeen Teeth ſix or eight Feet long, two Spans and a half broad, and weighing a hundred and twenty-five Pounds. I do not intend to meddle with that ancient Diſpute, *viz.* whether they ought properly to be called Horns or Teeth; nor at the ſame time will I deny, that I like the Opinion of *Aldrovandus* and *Bochart* of their partaking of the Nature of both, as their Origin confirms, which was long ago obſerved by *Pauſanias*, who ſays, that they deſcend from the Temples, and ſo make their Way downwards and outwards, as he remarked in the Skull of an Elephant in *Campania*. The Teeth at *Tonna* had the ſame Situation, and the Obſervation of *Moulins* and *Ray* is no Objection to this, they deriving theſe Teeth from the upper Jaw, and deſcribing their internal Structure in this manner, *viz.* "*That they are hollow within, and filled with a Kind* "*of compact medullary Subſtance, with ſome Mixture of Glands*". *Ray* too adds, from an Obſervation of *Lieuwenhoeck*, "*That they are compoſed of very ſlender* "*Tubes joined to one another, which take their Origin at the inner Part or Ca-*"*vity of the Tooth, and terminate in the Circumference*". Beſides we evidently obſerved theſe Tubes in every Part of the Teeth at *Tonna*, together with different Layers of a Cortex, as it were going round them, by which we ſaw the different Years of the Elephant, or perhaps greater Periods of Life, marked upon the Teeth. But, to tell the Truth, neither of them had a larger Cavity, than juſt to ſerve for their Inſertion into the Head or Temple, or more properly the upper Jaw, nor does *Cardanus* nor *Aldrovandus* mention a larger in any of them. And although it is deſcribed, as being larger both in *Moulins* and *Ray*, yet they could only produce the Teeth of younger Elephants; for I imagine, that all thoſe of the older Kind have the ſame Structure as the Teeth at *Tonna*, and the Cauſe of the Difference is this, *viz.* in the older Teeth the Tubes and Layers of the Cortex are not only increaſed outwardly, but more and more compreſſed and compacted inwardly, and at the ſame time the medullary glandular Part is gradually contracted, and at laſt obliterated.

I proceed next to the Grinders, of which there were four of a prodigious Size and Weight in the Head at *Tonna*, agreeing exactly with *Ray*'s Deſcription in the following Words: "*The Mouth of the Elephant is provided with* "*four Maſſes of Grinders in each Jaw; for there are ſeveral Teeth ſo firmly* "*fixed into a ſolid hard Bone, as with it and with one another to make one con*"*tinued bony Subſtance. Theſe Teeth make eight or nine parallel Lines waved on* "*the Surface of the Maſs, and whiter than the reſt of the Bone. Each Maſs* "*of Teeth is inſerted by Gomphoſis into the Jaw: But the foremoſt Tooth in the* "*upper Jaw is fixed into the Jaw Bone with the Extremity of the other, and* "*being produced forwards parallel with the Palate of the Mouth, it ends at laſt* "*in a ſharp Point, which is received into a Sinus made on Purpoſe for it in the* "*Extremity of the Jaw*".

"*The Inciſors are altogether a wanting*". And indeed they are wanting too in the Elephant at *Tonna*; but each of the Maſſes of Grinders is compoſed of a hard Bone ſhining like Glaſs, and a Nucleus, and on their Surface they have twelve parallel Lines diſpoſed in a wavy Manner, whiter than the reſt. On each Side there are ſixteen of theſe Lines, and they are inſerted into the Jaws by Gomphoſis by the ſame Number of Cavities. Upon perforating theſe Teeth, we found them full of a hard reddiſh Subſtance, very like Medulla, with Veſſels and Nerves petrified. Beſides, in that Part which is prominent above the Jaw, there plainly appears a Smoothneſs for almoſt two Inches, ſuch as *Moulins* obſerved in the Teeth at *Dublin*. Nor needs the Number of eight Teeth in each Jaw in that in *Ireland* give us any Uneaſineſs, although *Gaſſendus* ſpeaks of the ſame Number in another Elephant at *Peireſcium*, which he felt by thruſting his Arm into its Mouth; for they are reckoned to be but four, not only by the Antients, as *Ariſtotle* and *Pliny*, but by the Moderns, as *Walter Schultze*, who lived a long Time in *India*, and in *Ray* too, who otherwiſe would not have ſaid that there are four Teeth in each Jaw, but in the Jaw on each Side. The Cauſe of this Difference may be owing either to the Variety of Nature; for as ſhe does not produce always the ſame Number of Teeth in other Animals, and even in Man himſelf, ſo likewiſe in Elephants; or in the Difference of the Age, ſo that the foremoſt Teeth having cut the Gum, while the Animal was young, and being plentifully ſupplied with Nouriſhment, they filled up the Place where the others ought to ſprout out. It is certain, that the four Teeth at *Tonna* in the back Part have their Extremities and Proceſſes manifeſtly crooked, from which it is plain, that they were placed at the Extremity of the Jaw. Their anterior Part too ſhews the ſame Thing, and thoſe that were inſerted into the upper Jaw are not only longer than thoſe of the lower, according to *Moulin*'s Obſervation, but they end in a ſharp Point, as *Ray* has obſerved. Nay, they fill up almoſt the whole Space that *Moulin*'s eight did; for he meaſured the Length of the foremoſt Tooth of the lower Jaw to be ſix Inches and a half, and that of the backmoſt to be three; but the Length of that whole Jaw was only one and twenty Inches and a Quarter, as that of the upper was only eighteen. The Diggers at *Tonna*, not obſerving this Difference in the Length of the Jaws ſufficiently, called them both alike long, *viz.* three Feet, or ſix and thirty Inches. They found the Jaw Teeth ſtanding cloſe by one another, and the Length of each of them they called a Span and a half; but upon inquiring more narrowly I found it to be different; for the upper Teeth, upon Account of their ſharp Point, were almoſt fifteen Inches, and the lower ones only fourteen. The Length of the Jaws, which the ſame Workmen gave in, was three Feet and a half, or forty-two Inches, which being compared with the twenty-one Inches, which *Moulins* allows between the two *Oſſa Jugalia*, we will find, that the Elephant at *Tonna* muſt have been twice as large as the one in *Ireland*. And this is confirmed by the Length of the Cranium from the one Extremity to the other, that in *Ireland* being only twenty Inches and a half, whereas that at *Tonna* was three Feet and a half.

There were likewiſe found the Vertebræ of the Neck, which (according to the Dimenſions taken by the Diggers) were four Spans in Circumference, and two in Heighth. There are three of them ſtill remaining, which correſpond with one another, and the uppermoſt of them is pointed at Top. There was found too the Shoulder-bone, with the Acetabulum, and two large Heads or Globes, which are ſtill remaining, together with the Bones of the Fore-feet, the Ulna, Radius, Carpus, and Metatarſus, ſome of which have ſuch a large Cavity as you may thruſt your whole Hand into it. They are all filled not with Sand, but with very ſmall Particles of petrified Medulla, which, being put into the Mouth, do not occaſion a Noiſe between the Teeth like Sand, but melt upon the Tongue, and diſcover their being changed by the earthy Taſte which they leave in the Mouth. The Vertebræ of the Back were found too, with the Ribs ſtanding out from them, but there was none of them left entire. I only ſaw two ſmall Fragments of Ribs, one of which was eleven Inches thick, and the other more than ſeven. There was likewiſe found the Os Coxendicis of two Feet and a half in Length, together with the Acetabulum, and the Head of the Thigh-bone fixed into it. *Moulins* does not mention the Length of this Bone, but the Os Innominatum, he ſays, was twenty-five Inches; but the Os Coxendicis is only a third Part of the Os Innominatum, and the other two, *viz.* the Ilion and Pubis, the Diggers neglected to meaſure. There were found alſo the Thigh-bones, with thoſe of the hind Legs, the Tibia, Fibula, Tarſus, and Metatarſus; and there is ſtill remaining a Part of the Tibia, wanting the two Extremities, in its upper Part however two and twenty Inches thick, and above you may eaſily ſee that it muſt have increaſed to ſix more. In the lower Part of the Tibia it is ſeventeen Inches thick. Whence it appears, that the Circumference of this Bone, where it is largeſt, meaſures twice the Length of the one in *Ireland*, which *Moulins* ſays was nineteen Inches long; at its thickeſt Part more than fourteen Inches thick, and where it was ſmalleſt, ſeven Inches and a half. I muſt here obſerve, that the fore Legs of the Elephant are thicker and ſtronger than the hind ones, and this is explained by *Albertus* and *Aldrovandus*. Neither is the Tibia ſo capacious as to allow the Hand to be thruſt into it, which you might do into ſome of the Bones, and the Ulna, without Doubt, as both the Diggers and others relate. Laſt of all, there ſtill remain two Bones of the Tarſus contiguous to one another, leſt any Body ſhould queſtion theſe Bones being there.

All theſe Bones are porous and full of Chinks, as they are in other Animals, and quite of a different Form from the Teeth, both the Grinders and the Tusks.

It may likewiſe be worth while to mention the Poſition of the whole Skeleton, as it was found under Ground. The Horns, or great Teeth, pointed towards the North-Eaſt; the left fore Foot lay extended by the Side of the Head, and the right one was inclined downwards under the Body; the left hind Leg was bended at the Acetabulum, and the right, which was firſt found, was diſtorted ſeveral Ways. All which plainly ſhew, that the Poſition was by no Means natural or common, but unuſual and violent. In ſhort the Diggers tell us, that the Bones lay all in their natural Order, but at the Articulations, ſome of them were a Hand-breadth, and others of them half a Hand-breath (by a Hand-breadth here, I mean four Inches) diſtant from one another. Which muſt have been owing to the Fat, Ligaments, and Cartilages, *&c.* waſting away, and the Space, which they took up, being afterwards poſſeſſed by Sand, which by its Weight had ſeparated the Joints more and more from one another.

I come now to examine another Hypotheſis, *viz.* whether theſe belonged to a Foſſil or Mineral Unicorn bred under Ground, or were rather the Bones of a putrified Animal? No Body, who knows any Thing of natural Philoſophy, will deny, that there are Foſſil or Mineral Subſtances found, reſembling very large Skulls, Teeth, and Bones; and how Nature produces ſuch large Skulls, and other Parts reſembling thoſe of the human (and I may add of the animal) Body, as the Thigh-bones, the Tibiæ, Ribs and Teeth, *Kircher*, I think, has explained moſt clearly and rationally of any. He ſays, “ *That* “ *in the Bowels of the Earth within the Chaps of rocky Mountains, there is a* “ *Kind of ſlimy Earth, which with* Agricola *I have before called* Marl, *mixed* “ *with a Sort of* Parget, *which Earth, meeting with a nitrous Solution in the* “ *Chinks of the Mountains, is covered over as it were with a Shell of* Parget, “ *which as it petrifies with Time, ſo likewiſe by the Luſtre of the Nitre it reſem-* “ *bles very much a Bone in Whiteneſs, being both white, porous, and brittle. If* “ *then it meets with a round Cavity in the Earth, it produces a round Ball,* “ *which, being broke very much, reſembles a Skull, or if the Mould, in which it* “ *is caſt, has the Form of a human Thigh-bone (or that of another Animal) or* “ *of a Rib, or any other Bone, the* Marl, *that is contained in it, having the* “ *nitrous Liquor added to it, will reſemble the human Os Femoris, &c. which* “ *will be leſſer, larger, very great, and almoſt gigantic, according to the Size of* “ *the Mould it happens to be caſt in. And theſe are the Bones which Nature pro-* “ *duces, and which are ſometimes called the Bones of Giants by the Vulgar; but* “ *if you break them, there is no medullary Subſtance to be found in them, which* “ *ought to be the Caſe, were they the Bones either of Men or other Animals.*” Theſe Obſervations *Kircher* confirms from his own certain Experience, having ſeen in the Sides of the Cave at *Palermo* Teeth of all Sizes, ſmall, middling, great, nay, monſtrous large, having the ſame Appearance with thoſe of Animals, and in ſuch great Abundance, that he believes you might eaſily load a hundred Carts from thence. In other Parts there ſtuck out Vertebræ, Knee-pans, Parts of Tibiæ and Skulls, but in no Kind of Order; nor amongſt

Mund. ſubter. lib. 8. c. 4.

mongſt them all could he find any organized like the Head, Hands, or Feet; whence he plainly confeſſes, that he firſt was informed of the wonderful Contrivance of Nature in forming of Bones, or ſtony Subſtances very much reſembling Bones, from the Marqueſs *Ventimiglia*, who accompanied him in that Search, and informed him of two Circumſtances which are very much to our Purpoſe; one was that in * *Solon*'s *Field* near the Sea, between *Trapani* and *Palermo*, there are ſtill dug up by the Peaſants the real Bones of Elephants, which in paſt Ages were brought from *Africk* to *Sicily* in the Wars between thoſe two Countries, and being killed there, were buried, and the Bones being afterwards diſcovered, are bragg'd of ſometimes by ignorant People, as thoſe of Giants. The other is, the Difference between the true Bones, and thoſe Mineral Subſtances, which reſemble them, *viz.* that the firſt retain always the Cavities of the Tibiæ, and the other Bones wherein the Marrow was contained; whilſt the others are all ſolid, without any ſuch Cavities. But the Bones at *Tonna* are ſo far from wanting the Cavities for the Marrow, or from lying without any Order, or having nothing of organized Bones in their Structure, that all theſe Marks of *Kircher* are evidently plain in them, and obvious to the Eyes of every Body that ſees them.

For whatever Bones are hollow and filled with Marrow in the Elephant, they are the ſame in our Skeleton. Neither ought we to trouble ourſelves about the Solidity of the Tusks, as far as to that Part where they are inſerted into the Jaw, ſeeing that is the Caſe in the largeſt Elephants. Beſides, they were all found lying in a natural Order, even though the Poſture of the Animal muſt have been violent, and not common. In ſhort, the Bones which *Kircher* calls organized, and which he ſought for in vain amongſt the Mineral Bones in the Cave at *Palermo*, appeared evidently in our Skeleton, even to the very leaſt of them.

The Skull was curiouſly marked with Holes for tranſmitting the Nerves and Blood-veſſels, nor was the Cavity for the Brain wanting, and the Medulla Oblongata as it goes out of the Skull. The Tusks ſtill retain their natural Colour, Smoothneſs, Striæ, Tubes, and Interſtices or cortical Layers, nay, the right one appears filed by the Animal while alive. And the Grinders agreeing exactly with *Kircher*'s Deſcription, are inſerted by Gomphoſis into Cavities or Sinuſes of the Jaw, which are ſtill full of a reddiſh, petrified Medulla. The Vertebræ of the Neck, which are pointed above, and the Bones of the Tarſus, agree exactly with one another. The large Heads of the Thigh-bones were joined with the Acetabula, and the Ribs with the Back-bones. But I ſhall not repeat any more of what I have ſaid before, ſeeing any Body, who conſiders theſe Things, will eaſily be perſuaded, that Nature in a Frolick, and left to herſelf, could never form an intire organic Body, whoſe Parts ſhould all correſpond to that of a compleat Animal. But if any will be obſtinate, and aſſert, that there are ſome Foſſil Unicorns, as they are commonly called, and Mineral Bodies having Cavities like Bones, I will anſwer him from *Kircher*'s Principle, which is founded upon Experience, that theſe Foſſils of his are not of the Mineral, but of the Animal Kind, leaving it to him to prove the contrary. For it is an unanſwerable Argument, which *Conringius* propoſes in his

* Agro Solonio.

Conjectures concerning the antient State of *Helmſtat*, p. 13. "*But that Nature is able of herſelf, without any Aſſiſtance, to make Bones quite perfect, ſuch as are formed in the Fœtus, and afterwards compleated by long Nutrition in the Adult, is abſolutely impoſſible. Neither can you attribute the making of ſo many Bones fit for a living Animal, and every Way perfect, only to a wanton Frolick of Nature, without the greateſt Abſurdity.*"

There is ſtill another Argument of no leſs Weight, which *Kircher* furniſhes with in the ſame Place, where he ſays, that according to the Difference of the Cavity, or the Diſpoſition of the Matrix in the Bowels of the Earth, the Marl produces different Reſemblances of Bones. Allowing then in the Sands at *Tonna* a Marl and a Fluid, or a petrifying Water, which *Kircher* calls a nitrous Solvent *, to meet with one another; yet can any Body ever imagine, that the Cavity or Matrix there was formerly ſo diſpoſed, as to repreſent the Skeleton of an Elephant in the extraordinary Poſture above deſcribed, which was filled afterwards accidentally with the melted Marl, and in Proceſs of Time increaſed to ſuch a Bulk? To be ſure the Nature is the ſame, the Matter the ſame; the Heat, the Humour, and the Nouriſhment from the Earth muſt all be the ſame; and the Manner of generating the whole is the ſame, and yet the Bones produced are very different from one another, according to the Difference of the real Bones of the Elephant. For Example, the Bones of the Head have a great many Cells; the Grinders are hard as Glaſs, and ſhining with a great many wavy Striæ; the Horns or Tusks are ſmooth, yellow, filed at the Point, and marked with Layers of Tubes and cortical Subſtances, and the reſt of the Bones are porous, and evidently formed according to the Rules and Manner of an organic Body. Now who, I pray, after conſidering all thoſe Circumſtances can ever allow himſelf to think, that theſe are Mineral Productions? Is not the Opinion of *Anſelmus Boetius de Boodt*, chief Phyſician to the Emperor *Rudolphus* the Second, more probable, Lib. 2. Cap. 242.? who, after he had ſaid, "*That the Marl, moiſtened or diſſolved by a ſubterraneous petrifying Water, flows like Milk through the Cavities of the Earth, and the thinner Parts being drained off, the thicker Part filling up the Cavities ſtops there, and all the Water being carried off, it concretes into the Form of Stones and Horns, which is the common Opinion both of* Kircher *and others:* He adds, "*but if this milky Liquor does not fall into a Cavity, but lights upon Wood dried with Age, and penetrates its light porous Subſtance, and the finer Parts of it exhaling the groſſer are left behind, at laſt, being concreted, it will change the Wood, and aſſimilate it to its own Nature, but in ſuch a Manner, however, as, that you can ſtill diſtinguiſh its Species, and ſometimes even the Smell of the Wood remains. What happens in this Manner to Wood, may likewiſe happen to Harts Horns, Elephants Teeth, and other Parts of Quadrupeds, if they fall into ſuch Places. Hence it is, that theſe Foſſil Horns differ much from one another, and few of them have the ſame Appearance, ſome reſembling Teeth, others the Shank Bones, and others Jaw Bones, or other Parts of the Body.*" *Olaus Wormius* in his *Muſæum*, Page 54, thinks, that this Opinion approaches very near to Truth. What ſhould hinder us then from acquieſcing in the Determination of thoſe learned Phyſicians,

* Fluor nitroſus.

cians, and expreſſing in their Words the Manner in which the Bones at *Tonna* were petrified, eſpecially as they evidently own, that not only the Teeth of Elephants, but likewiſe other Parts of Quadrupeds (and why not of the greateſt of them) may be changed in this Manner.

Grant then that any how, and at any Time (which we ſhall explain afterwards) there was an Elephant left upon the Sand Hill at *Tonna*, whoſe Bones, dried by Length of Time, a ſubterraneous Fire had calcined, and being then ſmooth and porous, that milky Liquor of *Marl* had entered them, and the Water being exhaled, the thicker Portion of it remained (the Particles of which in porous Bones may very eaſily be diſcerned from the bony Subſtance, upon Account of its Whiteneſs) and at laſt coagulated, to have changed the whole Skeleton of the Elephant into a ſtony Nature, but in ſuch a Manner as both the external and internal Figure of the Bones, and perhaps even the Smell of them ſhould ſtill remain. I have ſpoken doubtfully of the Smell, becauſe I have not yet examined that. But if *Boetius* means that Smell, which Wood and petrified Bones ſend forth when burnt, this I can aſſert from the lateſt Examination I have made upon theſe Bones, that, upon holding them near the Noſe, they have the very ſame Flavour, which Bones and Horns that are burnt uſually have. *Bartholine* gives ſome Examples of Ivory, or the Foſſil Elephant's Teeth, in his laſt Chapter upon the Unicorn, but he leaves it undetermined, whether they were Teeth hardened into Stone by lying long under Ground, or whether they were originally Stones formed by Nature accidentally in the Shape of Teeth. He owns, however, that each of them has its Foundation, if you will not grant either of them; adding, that the Examples and Cauſes of Petrifaction are not to be deſpiſed. He expreſſes himſelf in the ſame doubtful Manner about the Grinder of an Elephant, and a Tooth of the Roſemary-Tree turned into Stone or Flint. However, Dr. *Arngrimus* of *Iceland*, is entirely of our Opinion, which he illuſtrates with another Tooth of the Roſemary-Tree. *Antonius de Pozzis*, chief Phyſician to the Emperor, favours the ſame Opinion ſtill more avowedly in his Epiſtle to *Lambecius*, which this Author has added to the ſixth Volume of the Commentaries upon the Emperor's Library, p. 315, 316, together with a Figure of the Grinder of an Elephant. For he has not only that Tooth, but the Bones of the Thigh and Leg found at *Baden*, for the true Bones of an Elephant petrified; accounting for it in this Manner, that if they put on a ſtony Nature, this happens from the Earth in which they were buried, which inſenſibly, by its concentrating Principle, extracts and hardens the Seeds of Petrifaction. I find there are more petrified Elephants of the ſame Kind in the *Roman* Collections from an Obſervation of the famous *Ciampini*, which I met with in the *Ephemerides Naturæ Curioſorum*, for the Year 1668. p. 446.

Act. Med. Hafn. *Tom. I.* p. 38, 84. *Tom. IV. p.* 182.

He mentions Bones that were dug up of a ſurprizing Bigneſs, *viz.* the Thigh-bone, Scapula, and five of the Vertebræ, amongſt which was that of the Neck, which together weighed more than one hundred and eighty *Roman* Pounds, by moſt People taken for the Bones of Giants, and compared with others of the ſame Kind in the Town Repoſitories, eſpecially at *Chiſiano*, they were the largeſt of all. But a Doubt having been ſtarted, whether they were really the Bones of a Giant, or rather thoſe of an Elephant, there were Letters ſent to a learned Friend at *Florence*, deſiring him to ſend a Specimen of the Skeleton of the Elephant in the famous *Muſæum* of the Phyſicians there; which accordingly was done, and being compared with theſe Bones, it was unanimouſly agreed, that thoſe which were lately found, as well as thoſe which were preſerved in the Repoſitories, were the Bones of an Elephant, and we found likewiſe, that thoſe mentioned by *Pliny* moſt certainly belonged to an Elephant. *Ciampinus* adds, that there were collected beſides various other petrified Bones and Foſſil Teeth.

I will not deny, my good Friend *Magliabeek*, that upon recalling theſe Things to my Mind, when I was thinking upon the Bones at *Tonna*, I firſt took a Reſolution of explaining the whole Affair to you, being in good Hopes, that, the aforementioned Diſpute being happily decided by Means of the Skeleton at *Florence*, ours might be ſo too. But you may be very ſure, that the Elephant's Skeleton at *Tonna* has loſt the greateſt Part of its former bony Nature by the ſubterranean Calcination, analogous to the Chymical one, and is thereſore brittle like other calcined Bones, and of a very aſtringent Quality. And indeed, if there is an aſtringent Quality in native Ivory, which however is not obſervable to the Taſte, as *Aldrovandus* has remarked, why will not that rather diſcover itſelf, and adhere to the Tongue in Ivory, that by lying ſo many Years under Ground is calcined, and in a great Meaſure petrified. Neither are the Bones of Animals converted ſo much into Stone, as that there remain no intrinſic Marks of Bone about them, which may be extorted by the Help of Fire in a Chymical Examination. Theſe Things, being doubted, put us upon examining the Bones in that Way; and we found not only the Pieces of Bones, which were thrown into an earthen Retort, remaining of the Colour and Figure of *Spodium*, and having evidently the Smell of a burnt Bone or Horn, but Phlegm too in the Glaſs Receiver, which diſcovered Sal Volatile by the Taſte, and an Oil by the Fat ſwimming at Top. Afterwards being calcined in a Potter's Furnace, and becoming very white, they evidently ſhewed the ſmall Tubes and Striæ of the Elephant's Teeth. Then being decanted and inſpiſſated, to uſe the Words of the Chemiſts, the Sediment or Lixive contained a chryſtalline Salt, and the Phlegm was a great deal ſharper to the Tongue, the ſaline Speculæ ſwimming in it very beautiful to the Sight. All which are daily extracted from the Bones and Horns of Animals, but none of them from *Stones*, *Marl*, or *Oſteocolla*, becauſe you cannot calcine Stones, but they degenerate into *Lime*, the Cauſe of which *Kircher* attributes to the ſmall Quantity of Moiſture in them, whereby the ſpirituous Parts of the Stones, from the Oilineſs of the Sulphur, reſolve the fixed Parts into a *Calx*. Who then will ſcruple any longer to aſſent to my Opinion, and to own, that the Bones at *Tonna* are the real Bones of an Elephant, but calcined by ſubterraneous Heat, and in a great Meaſure petrified, which the Smell of earthy Sulphur, both in the Phlegm and Reſiduum, ſufficiently evinces? And this is the Reaſon, why neither a volatile Salt nor Oil could be expected in ſuch a Quantity as from recent Bones; and the more ſo, as even in theſe, according to the Obſervations of that *Engliſh* Phyſician, *Clapton Havers*, in his Oſteology lately publiſhed, the volatile Salt ſcarce makes up a thirtieth Part,

Mund. ſubt. Lib. X. cap. 4.

and the Oil little more than a twenty-fourth Part of the Bones. But who will deny, that ſuch a ſmall Quantity as that muſt be almoſt entirely abſorpt in the petrified Bones, ſo as ſcarce to leave the leaſt Portion behind?

But there is another Doubt ſtarted by ſome, which I have ſtill to remove, *viz.* whether ever there was an Elephant in Nature, whoſe Bones anſwered to the Bigneſs of theſe. Theſe Gentlemen I would adviſe by all Means to be quiet, and only read the Journals of *India* or *Afric*, where they will meet with Elephants, not only as large, but a great deal larger than ours. Indeed the one in *Ireland*, which ours has been frequently meaſured by, was ſcarce larger than that at *Antwerp*, which *Goropius Becanus* meaſured very accurately in Preſence of *Aldrovandus*, and found its Height to be eight Feet. But in the Skeleton in *Ireland* the Length of the Os Innominatum is twenty-five Inches, of the Thigh-Bone twenty-eight, and of the Tibia nineteen, which all together make ſeventy-two Inches, or ſix Feet. To theſe I add two Feet to fill up that Space, which the Feet themſelves, the Curvature of the Back, the Cartilages, Fleſh and Skin require; and thence I diſcover, as I ſaid before, the Height of the Elephant in *Ireland* to be eight Feet. But as we find, that the Bones at *Tonna*, by comparing them as above, are, at leaſt, twice as large as the others; hence we find, that this Elephant muſt have been about ſixteen Feet high. And this is ſo far from being an uncommon Height in theſe Creatures, that *Scaliger* in his *Exercitatio*, p. 204, has expreſsly mentioned the ſame Meaſure, relating from the Writers of Voyages to the *Indies*, that there are Elephants there above ſixteen Feet high. But there are Elephants ſtill larger. *Johannes Jacobus Saar* mentions in his Journal a certain Kind of Meaſure, called *Gobdel*, equal to three Quarters of an Ell (that of *Norimberg* I imagine, the Author being of that Country) and in the Iſland of *Ceylon*, thoſe Elephants which are ſeven, eight, nine, ten, or eleven *Gobdels* high, are valued at three or four hundred imperial Crowns, but larger than theſe he never ſaw. But the *Norimberg* Ell is about four Inches longer than two of thoſe Feet which I have hitherto meaſured by; whence it follows, that the Meaſure *Gobdel* is about one and twenty Inches, and therefore the largeſt Elephant ſeen by *Saar* was more than nineteen Feet high. *Philippus Pigafetto*, in his Deſcription of the Kingdom of *Congo* in *Africa*, affirms, that the Prints of the Feet of the largeſt Elephants there are four Spans in Diameter, that is, upwards of two Feet eight Inches. In the Elephant at *Antwerp*, the Diameter of the Soal of the Feet was one Foot and two Inches, or thereabouts. And comparing theſe Diameters of the Feet with the Height of the Body, we ſhall find, that the largeſt Elephants in *Afric* are upwards of eighteen Feet. From what has been ſaid it likewiſe appears, that the Elephants in *India* are larger than thoſe in *Africa*, which *Aldrovandus* and *Bochart* prove from ancient Writers. Nor do I doubt, but that Elephant's Rib was brought from *India*, which is ſhewn in the Anatomical Theatre of the Univerſity of *Leyden*, and according to its outer Curvature meaſures eight Feet, and where it is thickeſt towards its Conjunction with the Sternum, its Diameter is a Foot and about three Inches, as deſcribed by *Theodore Rickius* in his Oration *de Gigantibus*; whereas the longeſt Rib of that in *Ireland* was ſcarce thirty-two

Inches long. And as eight Feet contain ninety-ſix Inches, it follows, that that Elephant, whoſe Rib is preſerved at *Leyden*, muſt have been twenty-four Feet high; and the Elephants of *Coſrois*, King of *Perſia*, mentioned by an anonymous *Arabian* in *Bochart*, were at leaſt of that Height. *Some of them*, ſays he, *were twelve Cubits high*, *which is very rare*, *for the moſt Part of them do not exceed ſeven*. If the Cubit here is taken in the common Senſe, it is ſcarce equal to two Feet, or twenty-four Inches, and by this Means thoſe Elephants were of the ſame Height with that at *Leyden*. But I imagine, that *Coſrois* meaſured his Elephants by the old *Perſian* Cubit, explained by *Golius* in his Notes upon *Alferganus*, p. 74, 75. from an * *Arabian* Writer of *Goda*, each of which contained ſeven and twenty Inches. But, according to this Computation, each of thoſe Elephants muſt have been ſeven and twenty Feet high. O ſtupendous Height, and worthy of the Stable of a King! Which, whoever conſiders, will not wonder ſo much at the Size of the one at *Tonna*, which is more than one half leſs than thoſe of *Coſrois*.

But from whence could this Elephant, larger at leaſt than uſual, come into this Country, and to this Sand-Hill? This Queſtion of the learned *Magliabeck* has occaſioned a great many Conjectures amongſt the Curious, ſome of whom have alledged, that it was brought into this Country, and there buried by the *Roman* Merchants; others by *Attila*, others by *Charles the Great*, others by the *Counts of Glichen*, and others will have it, that it was brought there only the laſt Century. But, beſides that each of theſe Opinions labours under Difficulties which I now forbear mentioning, they may all be confuted together by various Arguments. Such as, that the Uſe of Ivory, which is very ancient, will not allow us to believe, that upon burying the Elephant there they ſhould neglect to take away the Teeth, which were very large and fine; nor could an Animal of that Size be eaſily tranſported from *India*, or *Africa*, in former Times, or even in latter Days; and it has been obſerved by others, that not the old ones, but the young ones are brought over into *Europe*; far leſs would any Body be at the Pains to dig a Pit of twenty-four Feet deep to bury a dead Elephant in. But the ſtrongeſt Objection of all is the Conſtruction of the Sand-Hill, which, being carefully examined, evidently diſcovers, that it had never been digged into, and afterwards filled up again. The firſt Layer of Earth is a black Mould four Feet deep; and this is ſucceeded by a ſandy Gravel of two Feet and a half, the Middle of which is filled up by a Kind of Chalk-Stones, and † a binding Earth. Next follow ſix Feet of a ſandy, white Clay, with two Inches of binding Earth again, and below that it is a Foot deep. After this comes a Layer of Gravel about ſix Feet thick, and laſt of all, a pure, white Sand, the Thickneſs of which is not yet diſcovered, becauſe in it the Skeleton of the Elephant appeared, before they had dug quite three Feet into it. Now had this Hill been dug into, and filled up again after the Elephant was thrown into it, theſe different Layers of Earth, Clay, Gravel, *&c.* would not have been found in ſuch a regular Order, but they would have found them all mixed with a black Earth, as we ſee every Day in digging of Graves. Far leſs could the Chalk-Stones grow to ſuch a Hardneſs, or the binding Earth ſpread its Roots

* *Arabi Geodætica.*

† *Oſteocolla.*

and Veins through the whole Hill, even to the very Surface, or grow in ſuch a Quantity, as to extend two Feet in the Middle of the firſt Gravel, which lay immediately below the black Earth, and under that again half a Foot, and then getting lower into the ſandy, white Clay, take up two Inches there, and below that again the Space of a Foot. There only remains then for us to judge, that this Elephant, at the univerſal Deluge, in which it periſhed with other Animals, both of its own and of different Species, being toſſed here and there in the vaſt Abyſs of Waters, at laſt, when they began to decreaſe, fell to the Bottom, and the Waters laid over theſe different Strata of Sand upon it, and theſe, being dried at Top, were, at laſt, covered with a black Earth. For as the different *Strata* of Sand prove, that the Hill at *Tonna* derived its Origin from the Flood, ſo the Depth of the black Earth confirms it; both which I ſhall explain in a few Words.

The firſt I ſhall do from ſome Obſervations of *Nicolaus Steno*, a celebrated Phyſician with you, in a Diſſertation upon the Diſſection of the Head of a Dog-Shark, added to his Specimen of Myology, all which, however, I cannot run through in an Epiſtle. He talks indeed chiefly of the Parts of thoſe Animals that live in Water, ſuch as Oyſter-Shells, and the like, dug out of the Earth. But the ſame Thing may be ſaid of the Parts of Land Animals dug up in the ſame Manner. For what *Steno* ſays of the Earth, out of which theſe Things are dug, may evidently be applied to the Hill at *Tonna*, ſeeing it is harder in ſome Places containing Chalk, and a cementing Earth, and ſofter in others, filled with Gravel and Sand, laid over one another in *Strata* running obliquely with Regard to the Horizon. But *Steno* argues very well upon this Subject: “ *That*, ſays he, *regards the ſoftening Quality of the Earth,* “ *as theſe Bodies are the ſofter* (*here I underſtand the Bones of our Elephant*) *and* “ *leſs able to bear the Touch, the deeper they are buried; and hence the Earth is* “ *ſo far from producing them, that it muſt rather deſtroy them. Nor let any one* “ *believe, that they are ſoft upon Account of their not being yet perfect; for thoſe* “ *Bodies, which are ſoft while they are firſt generated, have their Parts united* “ *together with a certain Glue, as it were (as you may ſee in the recent Barks of* “ *Pines and Almonds) but theſe Bodies, being robbed of that Glue or Cement, fall* “ *down into a Powder, and therefore that Softneſs is an Argument of their* “ *being deſtroyed, not of their being produced*”. What follows in *Steno* about that Earth not being compact, when theſe Bodies were produced, and that it was not only covered with Water, but even intimately mixed with it; nay, that it ought to be reckoned a Sediment of the Water heaped up gradually, can by no Means be applied to the Hill at *Tonna*. I ſhall only take the Liberty of quoting ſome Things from Pages 211, 212, *viz.* “ *That white Clay* “ *and Sand may be mixed with Water violently agitated, Torrents tumbling down* “ *upon Earth of that Kind, and the Agitation of Waters from the Winds, make* “ *it ſo evident, that it would be quite needleſs to inſiſt longer upon it. Nor is* “ *it a hard Matter to prove, that in ſtagnating Waters, even the cleareſt of them* “ *all, there are Sand, Clay, and Chalk-Stones, nay all Kinds of ſolid Bodies frequently found concealed*”. Who then will longer doubt, that the Sand-Hill at *Tonna* was produced from a Sediment of the Flood? *Jacobus Grandius*, a *Ve-*

netian Phyſician, produces more Arguments for this Hypotheſis from the Bowels of the Earth, in his Epiſtle concerning the Truth of the univerſal Deluge, and the Generation of Shells found far from the Sea, of which I ſhall only pick out the three firſt. " I. *In many of the higheſt Mountains, not only* " *of* Europe *and* Aſia, *but likewiſe of* Africa *and* America, *there remain ſtill* " *certain Marks of the Sea, which depoſiting Sediments there has produced* Strata " *uniform, and parallel to the Horizon, which no Reaſon can perſuade us could* " *have happened, except at the Time of the univerſal Deluge.* II. *The ſame* " *Opinion is proved by very long Tracts of Land covered with various Sand-* " *Hills, produced from the Sediment of the turbid Element that watered them at* " *that Time, and having a great Reſemblance with the Bottom of the Sea.* " III. *The great Gaps of Mountains, made by the Corroſion of Rivers and Tor-* " *rents, ſhew different ſolid Bodies produced from the ſurrounding Waters, con-* " *taining and petrifying variouſly various Bodies; as alſo various Sediments placed* " *hard by one another, abounding with true Shells and other Productions of* " *the Sea*".

But concerning that black Mould, which grew over the Earth after the Flood, *Rudbeckius*, a *Swediſh* Phyſician, has obſerved a great many Things peculiar, in the firſt Volume of the *Atlantica*, Chap. VI. which, being approved likewiſe by other learned Men, need not here be tranſcribed. But if they were to be applied to our Sand-Hill, you muſt know firſt, that in thoſe Mountains in the Foreſt of *Duringen*, which contain Metals, and are compoſed of the hardeſt Rock, I found that black Mould about two Feet thick, much thinner, however, as you deſcended. But in other Places it was equal to four Feet or more, *viz.* in the Vallies which firſt received it, waſhed down by the Rains from the Mountains. Which, as it anſwers *Rudbeck*'s Deſire, who wanted to know the Depth of the black Mould in the warmer Parts of *Sweden*, that are plentifully ſupplied with Rains, ſo it likewiſe ſhews that Mould to have been derived to the Hill at *Tonna* to the Depth of four Feet after the Flood, and thereby proves, that the Elephant could not have been buried there ſince. But what ſhould hinder us from joining to theſe foreign Phyſicians *Herman Conringius*, a *German*, who, in his Conjectures concerning the ancient State of *Helmſtat*, and the Country adjoining, wanting to prove, that this Country was likewiſe overflowed by the Flood, inſiſts chiefly upon three Arguments, which are founded upon the *Sea-Shells*, the *Bones of Beaſts*, and *Trees*, or *Parts of Trees*, which are found both upon the Tops of the higheſt Mountains, and in the deepeſt Caverns of the Earth. Amongſt the reſt he mentions Stakes for Hedges found ready prepared, and the Horns of *Buffaloes* found in the deepeſt Caves amongſt the Rocks of *Thuringen*, of which that of *Salze*, which is ſcarce a *German* Mile diſtant from *Tonna*, in the Mountain *Seebergen*, near to *Saxe-Gotha* (where the moſt beautiful Shell-Fiſh are likewiſe dug up) *Albinus* mentions to have been ſtill remaining, in his Chronicle of the Mountains of *Meiſſen*, Tit. 22. n. 7. to which may be added, perhaps not undeſervedly, the Leaves of Trees, Bundles of Wood, and Ears of Corn hanging to the Stalk, all which are found petrified in the Stone Quarry at *Tonna*, not far from the Hill where the Elephant was found.

There is a very ſingular Obſervation of *Conringius* expreſſed in theſe Words pag. 37. "*Beſides, theſe Trees are almoſt all ſituated alike*, viz. *with their Roots inclining North-Weſt, and their Tops South-Eaſt, the Cauſe of which you cannot, with any Probability, attribute to a Frolick of Nature. But it is moſt likely, that theſe Trees were blown down by the North-Weſt Wind, and covered over with a marſhy Earth from the Northern Ocean: Eſpecially as from that Quarter, and by that Wind, when it blows high, the whole Sea-Coaſt of* Germany, *even at this Day, is frequently threatened with Inundation*". And here ariſes a new Argument to ſupport my Opinion, ſince the Horns of this Elephant were pointed towards the North-Eaſt, and though this Poſition ſeems a little different from that mentioned by *Conringius*, yet it is to be conſidered that a Beaſt taken up by the Sea may move itſelf variouſly, whereas Trees remain in the ſame Poſition in which they were firſt left. And it is no Wonder that the Elephant, being toſſed by the huge Billows ſhould at laſt acquire an extraordinary and violent Poſition, and that the Bones after the Fleſh was decayed ſhould lie at a Diſtance from one another. And perhaps the Teeth or Horns were found to be bended inwards from this very Cauſe, although the Poſition of them is almoſt the ſame in the Head of the Elephant in *Ireland* as delineated by *Mowlins*, which doubtleſs would have been more accurately expreſſed if the greateſt Part of them had not been conſumed, ſo that that was more owing to the Putrefaction or Decay of the Parts than to the fatal Waves.

Mineral Maps, by Dr. M. Liſter. n. 164. p. 739.

XXXVIII. We ſhall then be better able to judge of the Make of the Earth, and of many *Phænomena* belonging thereto, when we have well and duly examined it, as far as human Art can poſſibly reach, beginning from the Outſide downwards. For this Purpoſe it was adviſeable, that a Soil or Mineral Map, as I may call it, were deviſed. It might be diſtinguiſhed into Countries, with the Rivers and ſome of the noted Towns put in. The Soil might either be coloured, or otherwiſe diſtinguiſhed by Variety of Lines or Etchings; but the great Care muſt be, very exactly to note upon the Map where ſuch and ſuch Soils are bounded. As for Example, in *Yorkſhire*, 1. The *Woolds*; *Chalk*, *Flint* and *Pyrites*, &c. 2. *Blackmoor*, *Moors*, *Sand-Stone*, &c. 3. *Holderneſs*; *Boggy*, *Turf*, *Clay*, *Sand*, &c. 4. *Weſtern Mountains*; *Moors*, *Sand-Stone*, *Coal*, *Iron-Stone*, *Lead-Ore*, *Sand*, *Clay*, &c. *Nottinghamſhire*; moſtly *Gravel*, *Pebbles*, *Clay*, *Sand-Stone*, *Hall-Plaiſter*, or *Gypſum*, &c. Now if it were noted how far this extended, and the Limits of each Soil appeared upon a Map, ſomething more might be comprehended from the Whole, and from every Part, than I can poſſibly foreſee; which would make ſuch a Labour very well worth the Pains. For I am of the Opinion, ſuch upper Soils, if natural, infallibly produce ſuch under Minerals, and for the moſt Part in ſuch Order.

Schemes of Sands, &c. Clays; By Dr. Liſter, n. 164. p. 740.

XXXIX. I have ſome Reaſon to think that Sand was once the moſt *exterior* and general Cover of the Surface of the whole Earth; becauſe all our *Northern Mountains* are more or leſs covered with it at this Day, and the higher the Mountains, ſtill the more, and the coarſer the Sand: becauſe the Rivers ariſing in the Mountains do yet daily bring it down in great Quantities. And that it has been ſo in all Probability, in all Ages, ſince the firſt Rains fell upon the Face of the Earth, ſeems to me to be Truth-like, in that the Sea-Shores, or Mouths of Rivers, are uſually barred with it; beſides the Sandy Sea-Grounds in moſt Places of the Sea, and which ſeems a clear Evidence for the Length of Time (for that the low Ground near theſe Rivers, which have been in all Ages upon Record, *Moſſes*) if you pierce ſo deep into them, as to diſcover their Bottom, you meet with this Mountain *Sand* in great Quantities, and in ſome Places a Moſs under that, and the ſame Sand-Bed under that. Now if we conſider how long theſe Moſſes or Turf is in growing, it being moſtly the Leaves and Roots of Plants, we muſt allow very many Ages for this Purpoſe. And altho' *Herodotus*, one of the moſt ancient Hiſtorians that are, boldly conjectures that the *Nile* in *Ægypt*, long before our Times, would be dammed up and uſeleſs by the great Plenty of Mud yearly brought down that vaſt River; yet it does not appear, that the Country is much different from what it was in his Time: ſo that the Sand and Mud is ſtill carried to Sea.

Another Argument of the Sand's being the univerſal Cover of the Face of the Earth, is, from the great Hardneſs, and conſequently the Durableneſs and unalterable Quality of this Mineral, above any other in Nature. For tho' many Things are called Sand, from the Smallneſs and little Coheſion, or Dryneſs of the Grains, yet this Kind of Mountain-Sand, above all others, keeps its natural and original Magnitude; and is not made (as moſt Sand is) by the Attrition or Wearing of one Particle of Stone againſt another, but is of a conſtant and durable Figure: and therefore, I ſay, it ſeems to me, for this Reaſon, to be the moſt fit for an Outſide or Cover to the Globe of the Earth.

It may be objected, that the uppermoſt Beds of Stone, on the *high Woolds* all over *England*, are ſoft *Chalk*, and on the ſmooth Surface no Appearance of *Sand*. This indeed is in Part granted: but that there is no where any *Sand* upon the *Chalk Mountains*, is not true; for to inſtance in thoſe inland *Sand-Hills*, above *Bulloigne* in *Picardy*, which *Sand* is the very ſame with that on the Sea-ſhore at *Calais*, and although this is not in *England*, yet the Sea hath but accidentally divided us. For from *Dunſtable* in *England*, even as far as the Walls of *Paris* by *Calais*, is, as it were, a continued *Woold* of *Chalk* and *Flint*. What Difference there is betwixt the *Woold's Mountain-Sand*, and that of the *Northern Mountains*, will beſt appear in the Table. Now the Nakedneſs of the *Woolds* is from the Smallneſs of its *Sand*, which readily yielded not only to the *Rain* that fell, but to the Wind alſo. Which is evident from that vaſt Tract of *Sandy Hills*, which bound the Coaſt of *France*, *Flanders* and *Holland*, and which have made their Coaſt ſo ſhallow in Reſpect of ours, as being in great Part blown off the *Yorkſhire*, *Lincolnſhire*, *Suffolk*, or *Eſſex* and *Kentiſh Woolds*, and wrapt up upon their Coaſts: and the Reaſon of this is partly from the more conſtant *Weſterly Winds* blowing over from our Coaſts; and alſo from the Meeting of the two Tides, *viz.* That of the *Channel*, and that other of *North Flood* upon their Coaſts.

I am very well aware, that the finding of *Cockle* or *Shells*, as moſt Writers are pleaſed to call them, upon Mountains, and Sand alſo there, is by the ſame *Herodotus* uſed as an Argument of a great *Deluge*, or *Inundation* of Waters; but, as I have elſewhere, I think, demonſtrated, that the Rock *Cochlites* are no Shells, ſo neither can I grant that the *Sand* was adventitious to the Mountains, but naturally originated there: for that it is there plainly to be found, ſome looſe, and the reſt in Beds, yet unlooſened, as I could name very many Places; for Inſtance, on *Silden* and *Thorp Fells* in *Craven*, this Mountain-Sand is a white and tranſparent Pebble, and as ſome of it is ſmall, and eaſily ſwept and blown away, ſo is there much of it upon the high Mountains mixt with white Pebbles of greater Size.

'Tis the Character of this Sand not to yield to Fire, as *Flint* will do; and tho' it agree with that and ſome other Metals to ſtrike Fire from *Steel*, yet it does not calcine, as *Flint* will be brought to do. And therefore this Sand is the true *Tarſo* of the *Italian* Mountains, of which the fine *Venetian Glaſs* is made; and for this Reaſon the *Flint Glaſſes* were here in *England* ill compounded, the Foreigners miſtaking the Materials, which yet our Country affords in Plenty all over the Northern, and (I doubt not) the Weſtern Mountains too: I have ſeen from the *Scots* Mountains very excellent and large.

A TABLE

A TABLE of Sand (*drawn up about the Year* 1673.) *Such chiefly as I have found in the* Northern *Parts of* England.

- *Sand*
  - *Sharp*, or *Rag Sand*, compoſed of ſmall tranſparent *Pebbles*, naturally found upon the Mountains, not calcinable.
  - *Fine*
    - *Fine*
      - *White*
      - *Grey*
      - *Reddiſh*
      - *Brown*
    - *Coarſe*
      - *Grieſly*
      - *Brown*
        - *Stitneham-Moor* in the Road waſhed up very *White Pebble.*
        - *Flamborough-Head*, of which the Light-Houſe there is cemented.
        - *Calais Sand* burns reddiſh, but falls not in Water.
        - *Seaton Banks* near *Hartlepool*, on the *Tee's Mouth.*
        - *Eſcrick* in the Gravel-Pit there; a Vein of exceeding fine Sand.
        - The *Pillow-Sand* in the *Baltick.*
        - In a Spring at *Heſlington.*
        - The *Sand* at the *Bath* in *Somerſetſhire.*
        - *Acome* near *York*, drifted Sand.
        - *Hutton Moor* Waſht.
        - *Thorp* Fells.
        - *Owze* at *York.*
        - *Nid* at *Mountain.*
        - Dug up at *Rawcliff* near *Snath.*
        - *Wharfe* at *Ickly* and *Denton.*
        - *Air* at *Carleton* in *Craven.*
        - *Eure* at *Craven.*
        - *Gauton.*
        - *Santon* in *Lincolnſhire.*
        - *Bromeby Common.*
        - *Skipwith Common.*
  - *Soft*, or *Smooth* with *flat* Particles
    - From *Lime-ſtone* with *Mica* of *Glittering* Particles.
      - At —— in *Yorkſhire.*
      - A Vein at *Oſwell-Bacon* in *Lincolnſhire*,

- Of *Weſtmorland*.
  - *Silver-like*
  - *Gold-like*
    - *Sea Sand* about the *Scilly Iſlands*.
    - In *Cleveland*, and about *Scarborough*.
    - *Ouze* Duſt or Sediment at *Rawcliff*.
    - A Vein of *Mica* in *Heſlington* Gravel-Pit.
    - *Mica Argentea* in *Red-Sand Rock*, near *Rippon*, plentifully.
    - *Mica Aurea* of *Cleveland*.

Clay ſeems to be another Coat of the Terreſtrial Globe in the more depreſſed and hollow Parts thereof. The Mixture of Sand and Clay is not unuſually called Earth: Yet, this Term being too large, it will be convenient, as I think, to limit it to ſuch a Mixture as we uſually find upon the Surface of the Ground; which hath ever in it, beſides ſuch Sands and Clays, as either the Soil naturally produces, or have by Floods and Winds, or other Accidents, been brought thither, a great Part of the rotten Parts of *Plants* and Animals: and in this Senſe, Turf is Earth, which is moſtly where the *Erica* or *Heath* grows, becauſe 'tis made up of the deciduous Leaves of that Plant, which, being by the Current of Showers brought together, make up the Moors, Moſſes and Fens, and in the Mountains, in hollow Baſons or Depreſſures without Vent, Moſſes of incredible Depth; one or two Fathoms ordinarily in the ſame Kind of black Earth, called *Peat* or *Turf*.

A Table of Clays.

- Clay
  - *Pure*, that is, ſuch as is ſoft like Butter to the Teeth, and has little or no Grittineſs in it.
  - *Greaſy*, to be reckoned amongſt the Medicinal Earth, or *Terræ ſigillatæ*.
    - 1. *Fuller's Earth*.
      - *Yellowiſh*.
        - At *Brickhill* in *Northamptonſhire*.
        - At .. under the *Yorkſhire Woolds*.
      - *Brown*, about *Hallifax*.
      - *White*, in *Derbyſhire Lead-Mines*.
    - 2. *Boli*
      - In *Cleveland*.
      - At *Linton* upon *Wharfe*.
    - 3. *Pale Yellow*, in the *Marle-Pit* at *Ripley*.
    - 4. *Cow-ſhot Clay*, or the Soap-Scale lying in *Coal-Mines*.
    - 5. A *dark blue Clay*, or *Marle*, at *Tolthrop*.

- **Clay**
  - Harſh and Duſty when Dry.
    - 6. *Creta* properly ſo called, or the Milk White Clay of the Iſle of *Wight*.
    - 7. The Potter's *pale yellow* Clay of *Wakefield Moor*.
    - 8. The blue Clay of *Bullingbrook* Pottery in *Lincolnſhire*.
    - 9. A blue Clay of *Bugthorp Beck*, in which the *Aſtroites* are found.
    - 10. Yellow Clay in the Seams of the red Sand Rock at *Bilbro*.
    - 11. Fine red Clay in the red Sand Rock at *Bilbro* and *Rippen*.
    - 12. A ſoft chalky blue Clay } at *Buttercrain*.
    - 13. A ſoft chalky red Clay } at *Buttercrain*.
  - Stony when dry.
    - 14. A red Stone Clay } In the Banks of *Whitcar-Beck*, near *Leppington*, and at *Houſam* in the *Milſcar*.
    - 15. A blue Stone Clay } In the Banks of *Whitcar-Beck*, near *Leppington*, and at *Houſam* in the *Milſcar*.
    - 16. Clunch, a white Stone Clay in *Cambridgeſhire*.
  - *Mixt*
    - With round Sand, or Pebble.
      - 17. The yellow Loame of *Skipwith Moor* in *Yorkſhire*.
      - 18. A red Sandy Clay in the right-hand Bank of the Road beyond *Collingham* near the *Lime-Kilns* going to ———
      - 19. A red Sandy Clay in the red Sand Rock near *Rippen*.
    - With flat or thin Sand, glittering with Mica.
      - 20. Crouch white Clay in *Darbyſhire*, of which the Glaſs Pots are made at *Nottingham*.
      - 21. Grey or blueiſh *Tobacco-Pipe* Clay at *Hallifax*.
      - 22. A *Red Clay* in the *red Sand Rock* at *Rotherham*.

A Sand-flood at Downham in Suffolk; By Mr. Tho. Wright, n. 37. p. 722.

XL. Theſe wonderful Sands have not yet exceeded one Century, ſince they firſt broke Priſon. Their Original is in a Warren in *Laken Heath* (a Town belonging to the *Dean* and *Chapter* of *Ely*, diſtant not above five Miles, and lying South Weſt and by Weſt of this Place;) where ſome great Sand Hills, (whereof there is ſtill a Remainder) having the Superficies, or Swerd of the Ground, as we call it, broken by the impetuous South Weſt Winds, blew upon ſome of the adjacent Grounds; which being much of the ſame Nature, and having nothing but a thin Cruſt of Barren Earth to ſecure its good Behaviour, was ſoon rotted and diſſolved by the other Sand, and thereby eaſily fitted to increaſe the Maſs, and to bear it Company in this ſtrange Progreſs.

At the firſt Eruption, I ſuppoſe the whole Magazine of Sand could not cover above 8 or 10 Acres of Ground, which increaſed into 1000 Acres, before the Sand had travelled four Miles from its Abode. All the Oppoſition it met with in its Journey hither, was from one Farm-Houſe, which ſtood within a Mile and a half from its firſt *Source.* This the Owner at firſt endeavoured to have ſecured by Force, and building of Bulwarks againſt the Aſſaults thereof; but this wing'd Enemy was not to be ſo oppoſed: Which, after ſome Diſpute, the Owner perceiving, did not only ſlight the former Works, but all his Fences, and what elſe might obſtruct the Paſſage of this unwelcome Gueſt, and in four Years affected that by a Compliance and Submiſſion, which could never have been done upon other Terms; in which he was ſo ſucceſsful, as that there is ſcarce any Foot-Steps left of this miſchievous Enemy.

'Tis between 30 and 40 Years, ſince it firſt reached the Bounds of this Town; where it continued for 10 or 12 Years in the Out-ſkirts, without doing any conſiderable Miſchief to the ſame. The Reaſon of which I gueſs to be, that its Current was then down Hill, which ſheltered it from thoſe Winds that gave it Motion; but that Valley being once paſt, it went above a Mile up-hill in two Months time, and over-ran 200 Acres of very good Corn that ſame Year. 'Tis now got into the Body of this little Town, where it hath buried and deſtroyed divers Tenements and other Houſes, and has inforced us to preſerve the Remainder at a greater Charge than they are worth. Which doubtleſs had alſo periſhed, had not my Affection to this poor Dwelling obliged me to preſerve it at a greater Expence than it was built. I have at laſt given it ſome Check: for by ſtopping of it four or five Years (what I could) with *Furze*-Hedges ſet upon one another, as faſt as the Sands levelled them (by which I have raiſed Sand-Banks near 20 Yards high) I brought it into the Circuit of about eight or 10 Acres, and then in one Year, by laying ſome hundred Loads of Muck and good Earth upon it, I have again reduced it to *Terra Firma:* I have cleared all my Walls, and by the Aſſiſtance and Kindneſs of my Neighbours (who helped me away with above 1500 Loads in one Month) cut a Paſſage to my Houſe through the main Body thereof.

At the other End of the Town divers Dwellings are buried or overthrown, and our *Paſtures* and *Meadows* (which were very conſiderable to ſo ſmall a Town, both for Quantity and Quality) over-run and deſtroyed: and the Branch of the River *Ouſe* upon which we border, (being better known by the Name of *Thetford* or *Brandon* River, between which two Towns we lie) for three Miles together is ſo filled with Sand, that now a Veſſel with two Load Weight paſſeth with as much Difficulty as before with ten. But had not the Stream interpoſed, to ſtop its Paſſage into *Norfolk*, doubtleſs a good Part of that Country had e'er now been left a deſolate Trophy of this conquering Enemy. For according to the Proportion of its Increaſe in theſe five Miles, which was from 10 Acres to 1500, or 2000; in 10 Miles more of the ſame Soil, it would have been ſwelled to a great Vaſtneſs.

It is obſervable, that the Situation of the Country in which this troubleſome Gueſt firſt took its *Riſe*, lies *E. N. E.* of a Part of the *great Level* of the *Fenns*, and is thereby fully expoſed to the Rage of thoſe impetuous *Blaſts* we yearly receive out of the oppoſite Quarter: Which I ſuppoſe acquire more than an ordinary Vigour by the *Winds* paſſing through ſo long a Tract, without any Check. Another thing which contributes to it, is, the extreme *Sandineſs* of the Soil, the Levity of which, I believe gave occaſion to that Land ſtory of the Actions that uſe to be brought in *Norfolk* for Ground blown out of the Owners poſſeſſion.

XLI. Beſides the *Bolus Armenus*, and the *Terra Sileſiaca*, there is an Earth found in *Hungary* about the River *Tockay*, thence called *Bolus Tockavienſis*, having as good Effects in Phyſick as either of the former.

An Hungarian *Bolus*, *By* * * * n. 1. p. 11.

XLII. *Soap Earth* is found only in two Places near *Duraclea*, a large open Village about 6 Leagues to the Eaſtward of *Smyrna*; and in a very flat Plain, about a League Weſtward of the River *Hermus*, and ſeveral Leagues from the Sea. 'Tis a fine *Soap*, and at the firſt gathering whitiſh Earth, which boileth or ſhoots up out of the Earth. 'Tis gathered always before Sun riſe, and in Mornings when there falls no Dew, ſo that a Stock muſt be laid up for the whole Year in the Summer Months. It comes up in ſome Places an Inch or two above the Surface of the Ground. But the Sun riſing upon it, makes it to fall down again. Every Morning there is a new Crop, tho' all be taken away which the preceding Day afforded. The Earth producing it lies low in both Places, and is in the Winter waſhy; 'tis cover'd, tho' but thinly, with Graſs.

The Soap Earth *from* Smyrna; *By Dr.* Edw. Smith. n. 220. p. 228.

Three hundred Drams of this Earth put into a *Retort in Balneo Arenæ* for 12 Hours *cum Igne Violento*, gave between 5 and 6 Ounces of an *inſipid Phlegma*, the Smell only ſuch as proceeds in ſuch Operations from the Fire.

Finding therefore no *Volatile Salt*, as what muſt have come over by the foregoing Experiment; 200 Drams calcined at a *Bagnio Fire*, in a *German Crucible*, were diſſolved in Water. The Compoſition of Earth and Water, boil'd into a *Lixivium*, made 500 Drams.

It was boiled for three Hours, ſtill ſcumming off the Froth, then *Filtrated*, after *Evaporated* over a gentle Fire; it was kept to *Chryſtalize*, and appeared of a fix'd Salt.

At the *Soap Houſes* they mix $\frac{3}{4}$ of Earth with $\frac{1}{4}$ of Lime, and diſſolve the Compoſition in boiling Water; where ſtirring it often with a Stick, there floats a-top a thick browniſh Subſtance, which *Scumming* off they preſeve in Baſons apart, and this *Scum* is much richer than the Liquor underneath; yet both are uſed in making the Soap. Into a large Copper Caldron they put 50 Kintals of Oil, applying a very hot Fire, which burns continually until the Soap is made. When the Oil has boiled, they begin to throw in of the Scum, and ſometimes of the Liquor from which the Scum was taken. They often repeat this throwing in of the Scum and Liquor for 13 or 14 Days, in which time the Soap is uſually perfected. The browniſh Scum, and what is uſeful of the Liquor, incorporating with the Oil, what is uſeleſs ſinks to the Bottom of the Caldron, where it is let out to make room for throwing in more. The Water thus let out, is again thrown upon a new Compoſition of Earth and Lime; but when the Liquor becomes wholly inſipid, 'tis then judged to be exhauſted. After 13 or 14 Days, when the Soap is finiſhed, 'tis laded out of the Boiler, and laid upon a Lime Floor to dry.

They proportion two Load of Earth of five Kintals each, to 50 Kintals of Oil; the Produce is between 70 and 80 Kintals of Soap.

The Earth is bought at a Dollar a Load, and the Soap, when this Account was made, at 6¾ a Kintal. There is employed in making Soap yearly at *Smyrna* 1000 Kintals of Oil.

Bringing Soap-Earth employs a 1000, or 1500 Camels daily, for eight Months; the four Summer Months being too hot for Camels to travel.

An ordinary Soap-Houſe produces 1000 Dollars a Year clear Profit, *communibus Annis*.

The Uſe of Turkiſh Ruſma; By Mr. Smith. n. 243. p. 295.

XLIII. This black Earth, which is call'd *Ruſma*, and ſeems as if it were burnt, muſt be beaten in an Iron or Marble Mortar to a fine Powder, and ſifted diligently; when you uſe it, take one part of the ſaid Powder, and two parts of unſlacked Lime; put theſe mix'd together into a Linen Rag, which infuſe in warm Water the ſpace of a *quarter* of an *Hour*, or till it becomes of a black Colour, then apply it to the Place from whence you would take the Hair; as ſoon as the Hair begins to be looſe, the Part muſt be waſhed with warm Water and Soap.

Coal Mines in Somerſetſhire; *By Mr.* J. Beaumont. *Ph. Col.* n. 1. p. 6.

XLIV. Within 5 Miles Northward of *Stony-Eaſton*, there are 6 diſtinct Coal-Works. The chiefeſt Obſervables I met within them, are,

1. The branched Clift, which uſually lies over the Coal, and is all wrought with the Repreſentations of ſundry ſorts of Herbs.

2. A Clift all interwoven with *Arboreſcent Marchaſites*, which commonly lies over the former, and is call'd by our Colliers the Thorny Clift.

3. We here obſerve, that ſome Coal Veins are much more tinged with *Sulphur* than others; a Vein being wrought in one of theſe Works ſome Years ſince, which received ſuch a Reſplendency from its Sulphury Tincture, that in all its Joints it ſeemed as though it was covered with leaf Gold, and hence by the Colliers it was called the *Peacock Vein*.

4. I may here take notice, that about four Years ſince, on one of theſe Works was found about 2 or 300 Weight of very good *Lead Ore* growing to a Vein of Coal, the *Ore* being tinged ſomewhat yellow by the Sulphur: We look upon this as a Rarity with us, none ever having been found in a Coal-Pit before; the ſulphurous Spirit being there generally too ſtrong for the Generation of that Metal.

A Subterraneous Fungus; *By Mr.* Jeſſop. n. 100. p. 6179.

XLV. 1. The *Fungus Subterraneus* I ſent you a large Quantity of, was gotten in rocky Lime-ſtone Ground, on a Common about two Miles diſtant from *Caſtleton*, in the *Peak* of *Darbyſhire*, 15 or 16 Yards deep, in the *Old-Man* (as they call a Mine formerly wrought and ſtopt up) cover'd with Earth, and that had either fallen or was thrown in. There is no Coal-Bed, that is known of, within 5 or 6 Miles of the Place.

By Dr. Liſter. ib. p. 6180.

2. The Pieces of this *Fungus* which I received, are much like *Peats*, or *Turff*, cut up in the high Moors, both in the ſooty Colour and inward Subſtance; this only is more clammy and tough, and dries not. And ſome of this *Fungus* Subſtance is very ſoft and like Gelly. In and about the more ſolid Pieces, (of which I have ſome half a Foot ſquare) are many big Lumps of a *Bituminous* Subſtance. This *Bitumen* is very inflammable like Roſin; it is very light, it breaks firm, and ſhines like good *Aloes*; and for Colour it is not much unlike it, ſave that it is more dark-coloured and purpliſh; yet there is much of it of a dark-green Colour. We diſtilled a Parcel of it, which yielded us an *Acidulous Limpid Water*; then a white Liquor, which was, I gueſs, from ſome of the oily Parts precipitate; and in the laſt Place, a copious yellow Oil, not unlike that of *Succinum*, or Pitch. In the Neck of the *Retort* we could diſcern no volatile Salt, as in the like Proceſs upon *Amber*. I have not read of any ſuch *Fungus* Earth, in which *Bitumen* naturally grows and adheres: And the finding of it in an *Old Mine*, doth much favour an Opinion of its being a vegetable Subſtance, either the very Subſtance of the Props of Wood they make uſe of in lining and ſupporting the *Grooves*, thus altered, or certain *Fungus*'s growing out of them. That Birch, of which there is great Plenty, and hath been vaſt Woods, all theſe mountainous Parts of *England* over, will yield a *Bitumen*, as *limpid* as the Sap is which runs from it by tapping, if we now had the Skill to extract it. *Pliny* is very expreſs, *l.* 16. *c.* 18. *Bitumen ex Betula Galli excoquunt*. And moreover it is certain, that much of that Wood, if not all, which is dug up in the high Moors of *Craven*, and which the People there call and uſe for *Candle Wood*, is no other than Birch, as it appears from the Grain and Bark; and yet this Wood kindleth, flames, and exudates a *Roſin*, which makes many pronounce it very Fir-Wood. Whatever this *Bitumen* is, which this *Fungus Subterraneus* yields, it much differs from the *Aſphaltum* of the Shops.

A Mineral Juice; *By Dr.* Liſter. ib. p. 6181.

XLVI. Mr. *Jeſſop* ſends me word, that Capt. *Wain* has given him a white Liquor reſembling Cream both in Colour and Conſiſtence, which he found in great Quantities in the bottom of a Coal-Pit 49 Yards deep. And Mr. *Geo. Planton* writes from *Sheriff-Hales* in *Shropſhire*, that in the Iron Mines, eſpecially that which the Country People there call the *White-Mine*, which yields the beſt Iron-ſtone, the Miners do commonly, upon the breaking of a Stone, meet with a great Quantity of whitiſh Milky Liquor, incloſed in the Center of it; they ſometimes find a Hogſhead contained in one Cavity. 'Tis in Taſte ſweetiſh; only it hath a vitriolick and iron-like Twang with it.

A Blackiſh Stone in Shropſhire, *yielding Pitch, Tar, and Oil; By Mr.* Martin Ele. n. 28. p. 5442.

XLVII. In *Broſely*, *Bently*, *Pitchford*, and other Places adjacent in *Shropſhire*, there lies over moſt of the Coal-Pits or Mines a *Stratum* or Layer of a

Blackiſh Rock, or Stone, of ſome Thickneſs, which is porous, and contains in it great Quantities of *Bituminous* Matter.

This Stone being brought to the Work-Houſe, is ground ſmall by Horſe-Mills, ſuch as are uſed for grinding Flints to make Glaſs of; the Powder is thrown into great Coppers of Water, where, by boiling, the *Bituminous* Matter is ſeparated from the Stony or Gritty, this laſt ſinking to the bottom, the other ſwimming at the top of the Water.

This *Bituminous* Subſtance being gathered together and evaporated, comes to the Conſiſtence of Pitch, and with the Help of an Oil diſtilled from the ſame Stone, and mixed with the Pitch, comes to be thinner, or like *Tar*; the Uſes of both which Materials, either for Shipping or otherwiſe, theſe Subſtances are ſaid to ſupply, nay even go beyond. And this has been tried on ſeveral Boats this 3 or 4 Years paſt, and does not crack as the ordinary Pitch or Tar, but always keeps black and ſoft, and therefore is propoſed to hinder the Worm from getting into the Ships pitched with it.

There is likewiſe diſtilled from this Stone, an Oil which may be uſed for Oil of Petre, or Turpentine, and has been tried by divers Perſons in Aches or Pains.

A Mineral Balſam in Alſatia; *By* * * * * n. 8. p. 135.

XLVIII. In the Valley called *Liberthal*, near *Geeſbach*, (an ancient Mine-Work in *Alſatia*) there runs out of a Cavern a foul, flattiſh, oily Liquor, which affords an excellent *Balſam*, by taking a Quantity of it, and putting it in an earthen Pot well luted, that no Steam may exhale; and then with a gentle Fire at firſt, but a ſtronger afterwards, boiling it for 3 Hours together, in which Space it will boil in a 4th Part, and an earthen Matter, like Pitch, will ſettle itſelf at the Bottom; but on the Top thereof, when cold, there will ſwim a fatty Subſtance, like Line Oil, limpid and ſomewhat yellowiſh, which is to be decanted from the thick Sediment, and then gently diſtilled in an *Alembick* in *Arena*; by which means there will come over two differing Liquors, one *Phlegmatick*, the other Oily, which latter ſwimming on the *Phlegm*, is to be ſevered from it. The *Phlegm* is uſed as an excellent Reſiſter and Curer of all the Putrefactions of the Lungs and Liver, and it heals all foul Wounds and Ulcers. The Oily Part, being diluted with double its Quantity of diſtilled Vinegar, and brought three times over the Helm, yields a rare Balſam againſt all inward and outward Corruptions, ſtinking Ulcers, hereditary Scurfs and Scabs. 'Tis alſo much uſed againſt Apoplexies, Palſies, Conſumptions, Giddineſſes, and Head-aches. Inwardly they take it with *Succory Water* againſt all Corruptions of the Lungs. It is a kind of *Petroleum*, and contains no other Mineral Juice but that of Sulphur, which ſeems to be thus diſtilled by Nature under Ground; the Diſtillation of an *Oil* out of Sulphur by Art, not being ſo eaſy to perform.

A Mineral Balſam in Italy; *By* S. M. Antonio Caſtagna. n. 79. p. 3059.

XLIX. In the Territory of *Bergamo* Sig. *M. Ant. Caſtagna*, upon the Confines of his *Juriſdiction*, lighted accidentally upon a not ordinary ſweet *balſamick Scent*, which directed him to a *Rocky Hill*, where he found the *Stones* harboured that Fragrancy, which was ſo ſtrong, and by Trials found ſo friendly to the *Uterus*, that being applied, they did in a very ſhort time cure it of any Evil 'tis ſubject to. Encouraged hereby, he made his Workmen dig into the very Bowels of the Hill, where he diſcovered Holes in ſome Stones, as if excavated by Art, of a greeniſh Colour, in which he found, as diſtilled by Nature, and kept in Veſſels, that *Liquor* and *Balſam*, which proved the Source of that *Scent*, which was limpid, and of a white Colour, like the White of an Egg, but ſomewhat *Oleaginous*, floating upon all ſorts of Liquors like *Oil*. Beſides, he met in the ſame Cavities ſome ſmall Grains concreted of the ſame Liquor, reſembling that which they call *White Amber*, which being chymically diſtill'd, had the ſame Odour with the Balſam.

Oſteocolla about Frankfort *on the* Oder. *by* J. Chriſtopher Beckman. n. 39. p. 771.

L. I find that *Oſteocolla* grows in a ſandy, yet not gravelly Soil, and not at all (that I know) in any rich or clayey Ground. It ſhoots down two Mens depth under Ground; the Branches moſt commonly growing ſtrait up, yet ſometimes alſo they ſpread ſideways. The Branches are ſome of them thicker, ſome ſlenderer, and the further they are diſtant from the common Stem, the thinner they are; the Stalk being thickeſt of all, uſually equalling the Thickneſs of an ordinary Arm or Leg, and the Branches the Thickneſs of one's little Finger.

Upon the Sand, which is here every where yellowiſh, there appears a whitiſh fatty Sand, which if it be dug into, hath under it a dark, fatty, and (how hot and dry ſoever the other Sand be) a ſomewhat moiſt and putrid Matter, like rotten Wood; which Matter ſpreads it ſelf here and there in the Earth, juſt as the *Oſteocolla* itſelf doth, and is called by thoſe whom I have employed to look for it, the Flower of this Subſtance. The *Oſteocolla* being thus found, is altogether ſoft, yet rather friable than ductile: Wherefore if one hath the Curioſity of getting out of the Ground a whole Piece of it with its Branches, he muſt very carefully remove the Sand every way from it, and then let it lie ſo a while; its Quality being, that remaining expoſed to the Sun for half an Hour, or ſomewhat longer, it grows to that hardneſs as 'tis found in the Shops.

It ſeems to be a kind of *Marle*, or to have great Affinity with it, of which we here have alſo great Store, yet not near thoſe Places where I have found *Oſteocolla*. It requireth alſo time to come to Maturity, which appears from hence, that in the very ſame Place where I digg'd ſome of it laſt Year, I this Year found other, yet with this Difference, that thoſe grew hard, after the manner before deſcribed, but theſe remain ſtill ſoft and friable, tho' now in the 5th Month.

The Cauſe of its being divided into ſo many Branches, I conjecture to be from the Roots, which ſpread themſelves here and there in the Earth, ſo that the Matter gathers and ſettles itſelf about them, and afterwards according to the Diviſion of the Roots, acquires a plantal Form and Appearance. Whence it ſeems alſo to proceed, that thro' the midſt of the *Oſteocolla* there always paſſeth a dark Line, which is thought to be a Piece of the *Root*. And it often happens, that the Stroke loſeth itſelf by little and little, and the *Oſteocolla* in the middle grows clear; which comes to paſs when the Root by the Corruption begun in the *Oſteocolla* is reduced to Powder. Yet have I found a Place hereabout, where the *Oſteocolla* was not hollow at all; but there I obſerved, that inſtead of ſettling about a big Root, it had gathered it ſelf about many ſmall Fibres; whence alſo this ſort had acquired Pores through its whole length, but no Cavity like the other.

Black Lead, by Dr. Plot, n.240.p.183.

LI. The Mineral Subſtance call'd *Black Lead*, found only at *Keſwych* in *Cumberland*, and there call'd *Wadt* or *Kellow*; by Dr. *Merret*, *Nigrica Fabrilis*, from its uſe in ſcoring, as the *Rubrica Fabrilis*, or the *Red Ochre* is; is certainly ſo far from having any thing of Metal in it, that it has nothing of Fuſion, much leſs Ductility; nor can it be reckoned among the Stones, for want of hardneſs; it remains therefore that it muſt have place amongſt the Earths, tho' it diſſolve not in Water, as moſt Earths will, except ſtiff *Clays* and *Ochres*; among the latter whereof I gueſs it may be reckoned, it ſeeming to be a ſort of cloſe Earth, of very fine and looſe parts, ſo burnt that it is become black and ſhining, diſcolouring the hands, as all the *Ochres* do: whence the moſt proper Name that can be given it, perhaps, may be *Ochrea Nigra*, or *Black Ochre*, being a ſtony ſort, as there are ſtony ſorts of the *Red* and *Yellow Ochres*, as well as Clay.

Iriſh *Slate, by* * * * *. n.243.*p*.271.

LII. It having been diſcovered to the *Philoſophical Society* at *Oxford*, by Mr. *Henwrick* Phyſician at *Worceſter*, that the *Iriſh Slate* pulveriz'd, and infuſed in Water for a Night or leſs, would impart its *Vitriolick Quality* ſo far forth to it, that it would ſtrike of a faint reddiſh Colour with Powder of *Galls* (as the *vitrolick Waters* of *Tunbridge*, *Aſtrop*, and divers others do) it led me to believe that theſe Waters, ſome of them, might as well iſſue from *Slate* as an *Iron Ore*, unleſs it ſhould appear, that this ſort of *Slate* were an *Iron Ore* too, which put me upon calcining it for 3 or 4 Hours, after the Manner of Dr. *Liſter*, to experiment whether it would then (like other *Iron Ore*) apply to the *Magnet*; wherein altho' I was altogether unſucceſsful, the *Magnet* not taking the leaſt Notice of it, yet it afforded me another Diſcovery altogether as ſatisfactory, *viz.* that upon Torrefaction, it was all become a *Yellow Ochre*, and would ſcore like it; which further perſuades me, that the *Yellow*, or rather *Orange-colour'd-Sediment* we find at the Bottom of theſe *Fountains*, comes rather from this ſort of *Slate*, than an *Iron Ore*: For I much queſtion, whether ſome of the *Yellow Ochres* (tho' it's plain the red ones do) come from, or are *Iron Ores*, becauſe the *Shotover Yellow Ochre* will not own the *Magnet* after 36 Hours Calcination, or better.

Chalk, and ſome other Bodies not properly Stones, tho' commonly reputed ſo; By Dr. Fr. Slare. n. 182. *p*. 114.

LIII. In a ſmall Treatiſe of the *Calculus Humanus*, I found reaſon to complain of the Impoſition of our Senſes upon our Conceptions, in calling that a *Stone* by its external Appearance, when it has no real Properties of a *Stone*. I have alſo, in this, Reaſon to except againſt *Chalk*, commonly taken for a *Stone*, for being brought to the *Hydroſtatical Examen*, (if that may be allowed as a Standard) it wants much of the true Conſiſtence of a Stone; for it wants much of that weight, which real Stones are proved to have in *Water*, and it may perhaps be better reckoned amongſt *Boles* than *Stones*. I found this true not only in Chalk, but various other Bodies taken for granted to be *Stones* at large: Some of which are nearer *Earths* than *Stones*, others have nothing but *Earth*, *Sulphur*, and *Metal*, and yet muſt be called *Stones*, as all *Marchaſites* are; of theſe the former, (namely the *Boles*) many of them fall ſhort of our Standard of *Stone*, others are more ponderous, and ſo exceed our Standard: Whereas true Stones, tho' differing much in hardneſs, whether *Pebbles*, *Flints*, *petrefy'd Waters*, &c. do anſwer the ſame Standard of *ſpecifick Gravity* that a *Diamond* does; which is, as about $2\frac{1}{2}$ to 1.

Imperfect Stone in Scotland, *by Dr.* Geo. Gordon. n. 175. p. 1157.

LIV. Upon the River *Done* near *Aberdeen*, a little below the Bridge, near the River's Mouth, there is a Bank, the Face of which is broken down, and it is full of *Stones*, which one would think were *in fieri*; they are all either round or oval, of different Sizes; the Faces of moſt of them are broken off, they are ſoft, and will eaſily rub down with your Hand, they are of different Grits and Colours, and are made up of different Sands and Clays mingled together: The Clay is ſoft both to Hand and Taſte, in ſome of them white, in others gray, tho' in ſome Places the Clay and Sand are harden'd to the Conſiſtence and Colour of ſuch oval Stones as we uſually ſee in the Fields; but where they are at the ſofteſt, the Bed that each Stone lies in, is always hard, and of another Grit and Colour.

A Stone-Quarry near Maeſtricht. *By* * * *. n. 67. p. 2051.

LV. There is an excellent *Quarry* within Cannon-ſhot of *Maeſtricht*, lying in a Hill, where there are about 25 Fathom of Rock and Earth over-head; it hath one Entry towards the River *Maeſe*, where Carts can paſs with great eaſe, and unload the Stones upon the brink of the River; the *Quarry* within being parallel to the Horizon, and elevated but very little above the River: It affords one of the moſt ſurprizing Proſpects, when well lighted with many Torches, that one can imagine. For there are thouſands of ſquare Pillars in large level Walks, and thoſe almoſt every where above 20, and in ſome places many more Foot high; and all wrought with much Neatneſs and Regularity.

This *Quarry* ſerveth the People that live thereabout, for a kind of impregnable Retreat, when Armies march that way. For being acquainted with all the Ways in it, they carry into it whatſoever they would have ſafe, as well their Horſes and Cattle, as their moveable Furniture, till the Danger be over; there being ſo vaſt a deal of Room, that 40000 People may ſhelter themſelves in it.

In this vaſt *Grotto* 'tis remarkable, that there is but little Rubbiſh, which ſhews both the Goodneſs of the Stone, and the Carefulneſs of the *Workmen*. And in divers places there are little *Pools* of *Water*, perhaps made on purpoſe for Beaſts to drink, and to ſerve for other uſes in time of need: For in no place almoſt are there any Droppings to be ſeen; nor are the Walks at all wet under foot: only it ſeems, that Rain gets in by the Air-Shafts, which for ſaving of Labour, and perhaps too, to make theſe *Pools*, are let down from ſuch Places commonly, as are the *Pools* thereabout; and ſo the Rain, that falls on the higher Grounds does eaſily find the way thither.

Quarries and Rocks in Auſtria *and* Hungaria, &c. *by Dr.* Ed. Brown. n. 59. p. 1050.

LVI. Upon the North-ſide of Mount *Calenberg*, two *German* Miles from *Vienna*, are Stones mark'd with Trees and Leaves. In the *Hermitage* of the *Camaldulenſes*, ſeated upon a Peak of this Hill, I ſaw fair ones, with which they paved the Walks in their Gardens.

Not far from *Manners Dorf*, is the Emperour's Quarry of Stone, out of which are made the beſt Buildings in *Vienna:* In which, whereſoever there is a Cleft or Separation of one Stone from another, the Water falling betwixt them, leaves a Petrefication; thereby, as 'twere, healing the Wound, by making a ſtony *Callus*, not exactly like the Parts which it joins together.

An *Engliſh* Mile from *Freiſtat* in *Hungary*, Northward, is a *Quarry* of Stone, out of which many great Stones are digged, tranſparent and reſembling *Sugarcandy*.

At *Banca*, two *Hungarian* Miles from *Freiſtat*, Northward, is a Quarry of *White Stone*, nigh the *Hot Baths* of that Place, over which is a Lay of *Chalk*, of about a Yard thick, very beautiful to the Eye, as being of all Colours except Green, ſo finely mixt, ſtreaked and ſhaded, that it ſurpaſſeth *Marble Paper*; and the Water dropping upon it, doth, as 'twere, varniſh it.

At *Schemnitz* in *Hungary*, famous for *Silver-Mines*, is an high Perpendicular Rock, part of which, from the Top to the Bottom, is naturally tinctured with a ſhining fair blue and green: And I have heard from a *Spaniard*, who lived long in the *Weſt-Indies*, that there is alſo a Rock like this nigh to the *Silver-Mines* in *Peru*.

The Mountain of *Cliſſura*, being a part of Mount *Hæmus*, as alſo Mount *Pyrlipe*, do ſhine like Silver, and Day and Night, either by the Light of the Sun or Moon, afford a glittering pleaſant Shew, cauſed by the great Quantity of *Muſcovy Glaſs*, wherewith theſe Hills abound. There are alſo *Talcum Rocks* nigh *Spital* in upper *Carinthia:* And a Hill nigh *Sarvizza*, which conſiſts of an Earth of a fine red Colour, out of which the red earthen Veſſels of that Country are made.

White Marble in Ireland, by Dr. Aſh, *Biſhop of* Cloyne. n. 243. p. 294.

LVII. A *Quarry* of *White Marble*, is lately diſcovered in the County of *Antrim*, and 'tis of an extremely fine Grain, ſoft at firſt, but grows very hard afterwards, like *Portland-Stone*.

Stones growing at the end of a Ruſh, by Sir R. Redding. n. 198. p. 663.

LVIII. I ſend you herewith ſome Stones of an *Amber Colour*, taken out of a Spring, called *Cranbourn Spring* near *Lough Neah*, which the Country People tell us, grow at the end of a little Ruſh, and drop off, and are to be found only on a *Mayday-Eve*, and good for God knows what: They look like the Germinations of ſome of your Salts, but in the Fire ſhew no ſigns thereof by crackling: They are Electrical and Angular, and being pounded, the Powder is white.

LIX.

The Icy Mountain Gletſcher, *by M.* Muratus. n. 49. p. 982. *By---to Mr.* Juſtel. n. 100. p. 982.

LIX. 1. The higheſt *Icy Mountains* of *Helvetia*, about *Valeſia* and *Auguſta*, in the Canton of *Bern*, about *Taminium* and *Tavetſch*, of the *Rhetians*, are always ſeen covered with Snow. The Snow melted by the Heat of the Summer, other Snow being fallen within a little while after, is hardened into Ice, which by little and little, in a long Tract of Time depurating itſelf, turns into a Stone, not yielding in Hardneſs and Clearneſs to Chryſtal. Such Stones cloſely joined and compacted together, compoſe a whole Mountain, and that a very firm one; tho' in Summer-time the Country People have obſerved it to burſt aſunder with great Cracking, Thunder-like. Such Cracks and Openings being by the Wind covered with *Snow*, are the Death of thoſe that paſs over them.

At the foot of theſe Mountains, are with great Labour digged out Chryſtals, which are found among other Foſſils, of two Sorts and Colours; ſome of them are darkiſh and troubled, which by ſome are called the *Chryſtal Ore*, to be plenteouſly found in the Aſcent of Mount *Gottbard*; others tranſparent, very pure, and as clear as *Venice Glaſs*, ſexangular both great and ſmall; as in the Mountains about *Valeſia*, and the Town call'd *Urſelen*, at the foot of the Hill *Sthelenin*, they are digged out, and ſold at a good Rate; one particularly ſold for 80 *l. Sterl.*

2. This *Icy* Mountain called the *Gletſcher*, is very high, and extends itſelf every Year more and more over the neighbouring Meadows, by Increments that make a great Noiſe and Cracking. There are great Holes and Caverns which are made when the *Ice* burſts; which happens at all Times, but eſpecially in the *Dog-days*. Very little of the Surface melts in the Summer, and all freezeth again in the Night. When the Sun ſhineth, there is ſeen ſuch a variety of Colours, as in a Priſm.

At the foot of the Mountain, a Rivulet iſſues forth from under the *Ice*, which is pretty deep and extremely cold.

There is ſuch another Mountain near *Geneva*, and upon the *Alps*. A certain *Capuchin* told me, he had been upon the higheſt of theſe Mountains, with a Trader in Chryſtal, who having driven his Hammer into one of theſe Rocks, and found it hollow and reſonant, made a Hole in it, and thence drew forth a Subſtance like Talk; which to him was a ſign there was Chryſtal. After which he made a great Hole with Gunpowder, and found Rock Chryſtal in it.

The Formation of Chryſtals, *By* P. Franciſco Lana, n. 83. p. 4068.

LX. Being in the *Val Sabbia*, at a Place called *Le Mezzane*, where I knew that Chryſtals are generated, I obſerv'd in a ſpacious Round of a *Meadow* ſeated on a Hillock, ſome narrow Places bare of all Herbs, in which alone, and no where elſe thereabout, Chryſtals are produced, being all ſexangular, both Points of them terminating in a Pyramidal Figure, ſexangular, likewiſe.

I was told, that they were produced from the *Dews*, becauſe (forſooth) being gathered over Night, the next Morning there would be found others at ſuch a time only, when it was a ſerene and dewy Sky. But when I had examin'd that in the Neighbourhood of that Hill, there was no Mark at all of any Mines, I did conclude that it might be a plenty of Nitrous Streams, which might withal hinder Vegetation in thoſe Places, and coagulate the Dew falling thereon; for *Nitre* is not only the natural Coaguſum of Water, as is manifeſt in artificial *Glaciations*, but alſo it ever retains the abovesaid *ſexangular* Figure, altogether like that of theſe Chryſtals. Which may alſo be the very Cauſe of the *ſexangular* Figure in Snow; this being nothing elſe but Water concreted by its natural *Coagulum*, which is a nitrous Exhalation. And to make it yet more manifeſt, that theſe are indeed Expirations of *Nitre*, I digg'd up ſome of the Earth, and drew a Salt from it, which had both the Taſte and Figure of *Nitre*; tho' ſome Grains of it were of a ſquare, others of a pyramidal Figure. And ſince theſe Chryſtals are only found in thoſe narrow Places, we may very probably infer, that from thence are raiſed the Exhalations, which do concrete the Dew; after ſuch a manner as the Vapour or Exhalation of *Lead* coagulates *Quickſilver*.

An odd Figured Iris; by Dr. Liſter. n. 110. p. 222.

LXI. I have not obſerved any Rock, or ſort of Stone, whether metalline or more vulgar, which has not its different ſort of Spart both for Colour and Figure, which is very common in our blue Lime-ſtone Rocks in *Yorkſhire*, out of which plenty of Lead-Ore is got. They are moſtly of a black Water, like the black Flint in *Chalk-Hills*, but there are of them, which have a purpliſh or *Amethyſtine* Colour, and ſome there are as clear as Chryſtal. They adhere to the Seams of the Rock, be it betwixt Bed and Bed, or wherever there are croſs and oblique Veins thro' the very Subſtance of the Bed. The ſmaller the Veins, the leſs the *Iris*. You will find of them as ſmall as Wheat Corns, and others an hundred times bigger. They ſhoot from both ſides the Steam, and mutually receive one the other.

They are figured thus, *viz.* a Column of 6 Plains, very unequal as to the Breadth: the end adhering to the Rock is always rugged, as a thing broken off, the other end of the Column conſiſts of three quinquangular Plains, very little raiſed in the middle: Theſe Plains too are very unequal. Let them hug one another, and be any ways ſtreightned and compreſſed in their ſhooting; yet the Number of Plains mentioned, both of the Column and Top, is moſt certain. The Places where infinite of them may be had, are *Rainſborough Scar* upon the *Ribble*, alſo in a Stone Quarry, near *Eſhton Tarne* in *Craven*.

Transparent Pebbles; by Dr. Liſter. n. 201. p. 778.

LXII. Theſe *tranſparent Stones* are of a conſtant Shape, and in ſome ancient Leaſes of Royal Mines, they are called *rough* or *mineral Pearl*, being reſplendent and bright, and figured like a Drop of Water. Some of them are exactly ſpherical, others like a half Globe, others like a half Oval, with an Edge raiſed on the top. It was not without reaſon that they were eſteem'd by the Ancients: For their *natural Poliſh* is not to be *counterfeited*, but very eaſy to be diſtinguiſh'd with a Microſcope, from the *artificial Poliſh* of *Glaſs* and *Chryſtals*. Now, *Gold*, *Silver*, *Diamonds*, *Pearl*, are for no other reaſon eſtimable, but becauſe they have certain indelible Characters, which all the Subtilty and Wit of Man hath not yet been able to counterfeit, notwithſtanding many Pretences thereunto: As *Gold*, for example, that it will endure the drowning

ing in *Antimony*; *Silver*, that it abides the Teſt of Lead; *Diamonds*, for that of themſelves, even without a Foil, they caſt a Luſtre; *Pearl* is valued becauſe of its Figures, and peculiar Brightneſs not to be imitated.

Theſe Stones are of the *Pebble Kind*, that is, not to be calcined by ſimple Fire, whereas moſt other figured Stones are calcinable with a very eaſy Fire. They are very hard and ſolid, and do not conſiſt within of *Laminæ*, or Flakes, but break every way with great Difficulty, and naturally throughout ſmooth.

Their Figure comes neareſt to that of the *Ombriæ*, and many of them are very *Ombriæ* in Shape. Other tranſparent *Ombriæ* I have ſeen, which yet are either very *Flints*, or of a *flaky* and ſoft Contexture, of the Nature of *Selenites*; and ſuch are to be found about *Filo-Briggs*, a noted Set of Rocks near *Scarborough*.

As theſe Stones are of a very different Nature and Texture from all other *Ombriæ* I ever yet ſaw, and having no *Veſtigia* of any *Spinæ* in any part of them, I may reaſonably enough conclude them to be Stones of their own Kind.

I am not averſe to think, after ſo manifeſt and conſiderable Diſcoveries as *Auguſtino Scilla* hath made in *Sicily*, that moſt of the *Ombriæ* have been *Echini*, and yet ſome of the Prickled, which Naturaliſts have hitherto call'd *Lapides Judaici*, may have belong'd to ſome of thoſe *Ombriæ*. But there are only 2 or 3 *Echini* yet diſcover'd, either in ours, or the *Mediterranean Sea*; whereas of the *Ombriæ* of *Europe*, beſides theſe preſent *Anomalous* Stones, there are at leaſt 20 *Species* figur'd and deſcrib'd by *Aldrovandus*, *Auguſtino Scilla*, Dr. *Plot*, &c. and in vaſt Quantities in moſt Counties of *England*: and I doubt not many more Species will yet be found out. All which are to be accounted for, as to the natural Places, in what Seas they are to be found at this day. And if not in the *European*, as I think they will not, how and whence they came hither into this Iſland in ſuch plenty.

LXIII. 1. Among the excellent *Diamonds* brought from the *Eaſt-Indies* by M. *Tavernier*, there is one weighing 112$\frac{3}{16}$ *Carats*, of a very fine Violet Colour, and two of a Roſe pale Colour; all three of an *Adamantine Hardneſs*, and upon that account eſteemed *Diamonds*.

Diamonds
By . . . . n. 102. p. 26.

2. The Parts of the World known to contain *Diamonds* are, the Iſland *Borneo*, and the Continent of *India extra & intra Gangem*: *Pegu* is likewiſe reported to have ſeveral, but the King contents himſelf with his Mines of *Rubies*, *Sapphires*, *Topaſſes*, *Emeralds*, *Gold*, *Silver*, *Braſs*, *Tin* and *Lead*.

By the Earl Marſhal *of* England, n. 136. p. 907.

The *Diamond Mines* on the Coaſt of *Coromandel* (of which I have viſited ſeveral) are generally adjacent to rocky Hills, or Mountains, whereof begins a great Ledge or Range, near Cape *Comorin*, extending in Breadth about 50 *Engliſh* Miles, ſome conjoining, others ſcatter'd; and running thence in Length quite through *Bengala*. In, among, and near theſe Hills, in ſeveral Places, are known to be (as it is believed moſt of them have) Mines.

The Kingdoms of *Golconda* and *Viſiapore*, contain in them Scope enough of Ground, known to have *Mines*, ſufficient to furniſh all the World plentifully with Diamonds; but their *Kings* permit digging only in ſome Places appointed, leſt, as it is imagined, they ſhould become too common; and withal for fear of tempting the threatning Greatneſs of *Aurenge Zebe*, forbidding alſo thoſe Places that afford the largeſt Stones, or elſe keeping Workmen in them for their own private Uſes.

1. In the Kingdom of *Golconda* (as near as I can gather from the beſt acquainted) are 23 Mines now employed, or that have been ſo lately.

Quolure was the firſt *Mine* made uſe of in this Kingdom: The Earth is ſomewhat yellowiſh, not unlike the Colour of our Gravel dried; but wetter in ſome places where it abounds with ſmooth *Pebbles*, much like thoſe that come out of ſome of our *Gravel Pits* in *England*. They uſe to find great Quantities in the Vein, if it may properly be ſo call'd, the *Diamonds* not lying in continued Cluſters, as ſome imagine, but frequently ſo very ſcattering, that ſometimes in the Space of ¼ of an Acre of Ground, digg'd between two or three Fathoms deep, there hath been nothing found; eſpecially in the Mines that afford great Stones, lying near the Superficies of the Earth, and about three Fathoms deep. The *Diamonds* found in theſe *Mines* are generally well ſhaped, many of them pointed, and of a good lively white Water; but it alſo produces ſome yellow ones, ſome brown, and of other Colours. They are of ordinary Sizes, from about 6 in a * *Mangelin*, (of which they find but few) to 5 or 6 *Mangelins* each; ſome of 10, 15, 20, they find but rarely. They have frequently a bright and tranſparent Skin, inclining to a *greeniſh* Colour, tho' the Heart of the Stone be purely white; but the Veins of theſe Mines are almoſt worn out.

* *A* Mangelin *is* 4 *Grains in Weight, ſaith* Linſchotten.

2. The Mines of *Codawillikul*, *Malabar* and *Buttepallem*, conſiſt of a reddiſh Earth, inclining to an Orange Colour, (with which it ſtains the Clothes of the Labourers that work in it;) they dig about 4 Fathoms deep. They afford Stones generally of an excellent Water, and chryſtalline Skin: ſmaller Sizes than thoſe of *Quolure*, *Ramiah*, *Gurem*, and *Muttampelle*, have a yellowiſh Earth like *Quolure*; their Stones like thoſe of the two former Mines, but mixed with many of blue Water. Theſe 5 Mines being under the ſame Government with *Melwillee*, where the Governour reſides; he has lately forbid their Uſe, and commanded all to repair to his Reſidence.

Currure (the moſt famous of them all, and moſt ancient) has been under Subjection of the King of *Golconda*; but about 25 Years ago was taken, with the Country of *Karnaticum*, from the *Hundue-Rajaes*, by the *Nabob Meer Jumla*. In it have been found *Diamonds* of a *Seize Weight*, which is about 9 Ounces *Troy*, or 81½ *Pago*'s Weight. It is only employed by the King for his own private Uſe. The *Diamonds* that are found in it, are very well ſpread, large Stones (it yields few or none ſmall) they have generally a bright Skin, which inclines to a pale greeniſh Colour, but within they are purely white. The Soil is reddiſh, as many of the others.

About 60 or 70 Years ago, a *Portugueze* went thither from *Göa*, and having ſpent in Mining all that he had, even to what wearing Clothes he could ſpare, while the Miners were at work for the laſt Day's Expence, he had prepared a Cup of Poiſon, reſolving if that Night he found nothing, to drink his laſt with the Concluſion of his Money; but in the Evening the Workmen brought him a very fair ſpread Stone, of 20 *Pago*'s weight, in Commemoration whereof he cauſed a great Stone to be erected in the Place, with an Inſcription engraven on it, in the *Hundues*, or *Tellinga* Tongue, to the following effect, which remains to be ſeen till this day:

Your Wife and Children ſell, ſell what you have,
Spare not your Clothes, nay, make your ſelf a Slave:
But Money get, then to Currure *make haſte,*
There ſearch the Mines, a Prize you'll find at laſt.

Not far from *Currure* are the Mines of *Lattawaar* and *Ganjeconta*, which are in the ſame Soil as *Currure*, and afford Stones not unlike: But *Lattawaar* hath many repreſenting the great End of a Razor Blade, thin on one ſide, and thick on the other, very white and of an excellent Water; but the beſt of the Mine is worn out, and *Ganjeconta* employed only to the King's private Uſe.

Jonagerre, *Pirai*, *Dugulle*, *Purwillee* and *Anuntapelle*, conſiſting alſo of red Earth, are now employed, and afford many large Stones, part of them of a greeniſh Water: but the moſt abſolute Mines are of *Wazzergerre*, and *Munnemurg*, (the other rather repreſenting Pits than Mines) for there they ſink thro' high Rocks, till they go ſo far below their Baſis, that they can go no farther for Water, in ſome places 40 or 50 Fathoms deep. The Superficies of the Rocks conſiſt of hard, firm, white Stone, into which they cut a Pit like a Well, of about 4 or 5, in ſome places 6 Foot deep, before they come to the Cruſt of a *Mineral Stone*, like the *Mineral* of *Iron*; then they fill the Hole with Wood, and keep as hot a Fire as they can there for 2 or 3 Days, till they think it ſufficiently heated; then they pour in Water till they have quenched it, which alſo ſlakes and mollifies both *Stone* and *Mineral*: both being cold, they dig again, take out all the crumbled Stuff, and dig up what they can beſides, before they heat it anew. The Cruſt ſeldom is thicker than 3 or 4 Foot, which ceaſing, they come to a Vein of Earth, that uſually runs under the Rock 2 or 3 Furlongs, ſometimes much farther. This they dig all out and ſearch, and if their firſt Attempt prove ſucceſsful, they go to work again, digging again after the ſame manner, as deep as they can, till they come to Water; for the drawing whereof, wanting the Help of Engines known in *Europe*, they can go no deeper, altho' the Vein lie lower: all Lumps of the Mineral they break in pieces, and frequently find Diamonds incloſed in them. The Earth is red, many large Stones are found here, the ſmalleſt about 6 in a *Mangelin*. They are mixed Waters, but the greateſt part good, only of ill-favour'd Shapes; many cragged Pieces of Stones, ſome as if they had been Parts of very great ones; others with Pieces broken of them; yet I never heard of any that found two ſeeming Fellows, altho' they do thoſe that look as if they had been newly broken.

In *Langumboot* they dig as they do at *Wazzergerre* and *Munnemurg*, the Rock is not altogether ſo ſolid, but the Earth and Stones it produces much alike.

Wootoor lies near *Currure*, and affords Stones of a like Magnitude, Shape and Waters; 'tis employ'd only to the King's uſe: and ſingular, in that its Diamonds are found in black Earth.

Muddemurg far exceeds all the reſt for *Diamonds* of a delicate Shape, Water, and bright tranſparent Skin; yet it has ſtore of veiny ones, but thoſe likewiſe of ſo curious Shape, and Water, that it is difficult to diſcover them from the good, eſpecially the ſmall ones. It produces *Stones* of divers Magnitudes, from 10 and 12 in a *Mangelin*, to 6 or 7 *Mangelins* each; and beſides, ſome great ones. The Earth is red: but it is ſeated in the Woods, and the Water ſo bad, that to all (except the People bred there) it preſently occaſions Fevers, and deſtoys abundance, inſomuch that moſt of the *Adventurers* have forſaken it: notwithſtanding which, it had been more profitable than any of the reſt, the Vein frequently lying near the Superficies of the Earth, ſeldom running deep, and is better furniſhed than any one yet diſcovered. The River *Kiſtna*, of excellent Waters, is but 9 Miles diſtant, but the Miners or Merchants will not be at the Charge of fetching their Water from thence. Divers are of the opinion, that beſides the Water, the Town lying in a Bottom, environ'd with Hills, and a Moraſs adjoining, the Air may be infected, and contribute to its Unhealthfulneſs.

Mekwillee, or the *new Mine*, ſo call'd, becauſe it was but lately found out, or at leaſt permitted to be made uſe of, in the Year 1670; it had then a Year employed the Miners, but it was forbidden, and lay unoccupied till 1673, when Complaints being made at *Quolure*, that the Vein was worn out, the King again licenſed its Settlement. The Earth they mine in is very red, and many of the *Stones* found there, have of it ſticking to them as if it had clung there while they were of a ſoft glutinous Subſtance, and had not attained their Hardneſs, maintaining its Colour on its Skin (ſeeming to be roughned with it) that it cannot be fetch'd out by grinding on a *rough Stone* with *Sand*, which they make uſe of to clean them. The *Stones* are generally well ſhaped, their Size from 5 or 6 in a *Mangelin* to thoſe of 14 or 15 each, and of ſome bigger; but the greateſt Quantities of the middle ſorts: Moſt of them have a thick dull Skin, incline to a yellowiſh Water, not altogether ſo ſtrong and lively as of the other Mines, very few of them of a chryſtalline Water and Skin. They are reported to be apt to flaw in ſplitting, which occaſions thoſe People to eſteem them ſomething ſofter than the Product of many of the other *Mines*; ſeveral that flatter by their ſeeming *Whiteneſs*, when rough, diſcover their Deceitfulneſs, having paſſed the Mill, and too often a yellowiſh Tincture, to the diſappointment and loſs of them that have cut them; but what they want in Goodneſs is in part ſupplied by the plenty they find, which, together with their Properties, make them the cheaper.

2. *Viſiapore* is known to contain Mines encloſing *Stones* as large and good as thoſe of *Golconda*, but the King makes uſe but of the meaneſt. There are 15 Mines employed in this Kingdom.

In *Ramulconeta-Mines*, in red Earth, about 15 or 16 Foot deep; they ſeldom find a *Diamond* of a *Mangelin* Weight, but ſmall, to 20 or 30 in a *Mangelin*. They are generally of an excellent *chryſtalline Water*, have a bright, clear Skin, inclining frequently to a pale greeniſh Colour, are well ſhaped, but few of them pointed ones. There are alſo found amongſt them, ſeveral broken Pieces of *Diamonds*, by the Country People called *Shemboes*.

The Mines at *Banugunnapelle*, *Pendekul*, and *Moodawarum*; at *Cummerville*, *Paulkul* and *Workul*, which are not far diſtant from *Ramulconeta*, afford Stones much alike, and in the ſame kind of Earth; but in the three laſt are very ſmall ones, even to 100 in a *Mangelin*.

Lungepoleur Mines are of *yellowiſh Earth*, like thoſe of *Quolure*; its *Diamonds* are generally well ſhaped, globular, few, pointed, a very good chryſtaline Water, and bright Skins; many of them have a thick dark Graſs-green Skin, ſome ſpotted alſo with black, that they ſeem all foul, yet are not ſo, but within purely white and clean. Their Sizes are from 2 or 3 *Mangelins* downwards, but few very ſmall. *Pootloor-Mines* are of a reddiſh Earth, but afford Stones much like thoſe of *Lungepoleur*, only ſmaller: under a *Mangelin*, the general Sizes are of $\frac{1}{2}$, $\frac{1}{3}$, $\frac{1}{4}$, $\frac{1}{5}$ of a *Mangelin*.

Punchelingul, *Shingarrampent*, and *Tondarpaar*, are alſo of red Earth, their Diamonds not unlike thoſe of *Quolure*, only rarely or never any large ones are found there.

Gandepellee hath the ſame Earth with the former, and produces Stones of equal Magnitude; but frequently of a pure *chryſtaline Water*, wherein they exceed the former.

Donee, and *Gazerpellee*, dig both in red Earth likewiſe, and afford Stones alike, the greateſt Part whereof are of good Shapes and Waters. They have alſo many *Shemboes*, and ſome of bad Waters, ſome brown, which theſe People call ſoft, or *weak water'd*, being eſteem'd of a ſofter and weaker Body than others, by reaſon they have not ſo much Life when cut, and are ſubject to flaw in ſplitting, and on the Mill. Their general Product is in *Stones* of middle Sizes: but *Gazerpellee* has beſides many large ones, and is the only Mine noted in the Kingdom of *Viſiapore*.

The *Diamonds* (in all the *Mines*) are ſo ſcattered and diſperſed in the *Earth*, and lie ſo thin, that in the moſt plentiful Mines it's rare to find one in digging, or till they have prepared the Stuff, and do ſearch purpoſely for them. They are alſo frequently incloſed in *Clods*: and ſome of thoſe of *Melwillee* have the Earth ſo fixed about them, that, till they grind them on a rough Stone with Sand, they cannot move it ſufficiently to diſcover they are tranſparent; or, were it not for their Shapes, to know them from other *Stones*. Sometimes the unſkilful Labourers, to try what they have found, lay them on a great *Stone*, and ſtriking on them with another, to their coſtly Experience, diſcover they have broken a Diamond.

Near the Place where they dig, they make a *Ciſtern* about 2 Foot high, and 6 Foot over, with a ſmall Vent in one of the Sides, about 2 Inches from the Bottom, by which it empties itſelf into a little Pit made in the Earth to receive ſmall Stones, if by chance any ſhould run thro'. The Vent being ſtopped, they fill the Ciſtern they have made with Water, ſoaking therein as much of the Earth they dig out of the Mines, as it can conveniently receive at a time; breaking the Clods, picking out the greateſt Stones, and ſtirring it with Shovels till the Water is all muddy, the gravelly Stuff falling to the Bottom: then they open the Vent, letting out the foul Water, and ſupplying it with clean, till all the earthy Subſtance be waſhed away, and none but a gravelly remains at the Bottom. Thus they continue waſhing till about 10 of the Clock before Noon, when they take the gravelly Stuff they have waſhed, and ſpread it on a Place made plain and ſmooth like a Bowling-Alley, for the Purpoſe, near the Ciſtern; which being ſoon dried by the Heat of the Sun, at that time of the Day, they very curiouſly look it over, that the ſmalleſt Bit of a Stone can hardly eſcape them. If they find a large Stone, they deliver it not till they have done work; and then very privately, leſt it ſhould come to the Knowledge of the Governour of the Place; and he require a Share, which in the Kingdom of *Golconda* is uſually practiſed, without reſpect to any Agreement made with them.

The Miners, thoſe that employ them, and the Merchants that buy the *Stones* of them are generally *Ethnicks*; not a *Muſſulman*, that ever I heard of, followed the Employment. Theſe Labourers and their Employers are *Tellinga's*, commonly Natives of or near the Place. The Merchants are the *Banians* of *Guzzarat*, who, for ſome Generations, have forſaken their own Country to take up the Trade, in which they have had ſuch Succeſs, that 'tis now ſolely engroſſed by them; who correſponding with their Countrymen in *Surat*, *Goa*, *Golconda*, *Viſiapore*, *Agra* and *Dillee*, and other Places in *India*, furniſh them all with Diamonds.

The Governours of the Mines are alſo Idolaters. In the King of *Golconda*'s Dominions, a *Feulinga Bramme* rents moſt of them, whoſe Agreement with the Adventurer is, that all the Stones they find under a * *Pagoda* Weight, are to be their own, all of that Weight and above it, to be his for the King's Uſe. Both Merchant and Miner go generally naked, only a poor Clout about their Middle, and a Saſh on their Heads; they dare not wear a Coat, leſt the Governour ſay they have thriven much, are rich, and ſo enlarge his Demands on them. The wiſeſt, when they find a great Stone, conceal it till they have an Opportunity, and then with Wife and Children run all away into the *Viſiapore* Country, where they are ſecure and well uſed; by reaſon whereof, their Mines are much more populous, and better employed than thoſe of *Golconda*.

* *A Pagoda's Weight is* 9 *Mangelins.*

It is obſervable, that notwithſtanding the Agreement with the *Adventurers* of the *Mines*, that all *Stones* above a certain Weight ſhall be for the King's Uſe; yet in the *Metropolis* of either Kingdom, as the Cities of *Golconda* and *Viſiapore* are, there is no Seizure, all Stones are free: and the late deceaſed King, *Abdub Cutopſhaw* of the former, and *Edelſhaw* of the latter, would not only give very great Prices for large Stones, but richly veſt, and preſent the Merchant that ſold them with Horſes, or ſomething elſe of Value, thereby encouraging others to bring the like.

The Production of Amber; By Mr. John Schefferus. n. 19. p. 349.

LXIV. 1. Mr. *John Schefferus* conceives Amber to be a kind of Foſſile Pitch, whoſe Veins lie at the bottom of the Sea; believing that it is hardened in tract of Time, and by the motion of the Sea caſt on Shore. He adds, that hitherto it hath been believed, not to be found but in *Boruſſia*: But he aſſures that it is alſo found in *Sweden*, on the Shores of the Iſle of *Biorkoo*, in the Lake *Melero*, whoſe water is ſweet. Of this he ſaith he hath a fine Piece by him, two Inches large and thick, preſented him by one that himſelf with his own Hands had gathered it, and ſeveral other Pieces, on the Shore of the ſaid Iſland; affirming withal from the Mouth of a Shepherd of that Place, that it is thrown out by a ſtrong Wind, bearing upon the Shore.

By Mr. Hevelius ib. p. 346.

2. I am alſo of the ſame Mind with Mr. *Schefferus*, that *Amber* is a kind of *Foſſile Pitch*, or *Bitumen*, ſeeing it is not only found on the Shore of the *Boruſſian* Sea, but alſo digged up in ſubterraneous Places, ſome *German* Miles diſtant from the Sea; and that not only in ſandy, but alſo in other Hills of firmer Earth; of which I have ſeen my ſelf pretty big Pieces.

An Account of Amber; *By Mr*. Phil. Jac. Hartman. n. 248. p. 5.

3. The Virtues of *Amber*, which were known ſeveral Ages before *Chriſt*, got it a celebrated Name amongſt the *Greek* Writers. Afterwards it began to be admired amongſt the *Romans*, and was rendered a memorable Gem by theſe Authors; eſpecially when the diſſolute Manners of *Nero* taught them to abuſe it, by introducing it into their Luxuries. But how much ſoever Amber was eſteemed in former Ages, yet the Countries which produced it remained ſtill unknown; whence aroſe ſuch a great Diverſity of Opinions; ſome ſaying, that this Treaſure was concealed in *Africa*, others in *Aſia*, and others in *Europe*. In this laſt, *Italy* eſpecially near the *Po*, and the Coaſt of the *Adriatic* Sea, was reckoned richeſt in *Amber*, which however more authentick Accounts, when the victorious *Romans* over-run all *Germany*, have given the Honour of to the Iſlands on the *German* Ocean and *Baltick*, *Spain*, and *Britain* coming in for a Share of it.

But though the Ancients might be excuſed for alledging ſo many Countries to be productive of Amber, I know not whether the laſt or this preſent Age, is to be pardoned for deriving the native Amber even to this Day from *Africk*, *Aſia*, and even from *America*, publiſhed likewiſe by the Name of Oriental Amber. The moſt Part of theſe Authors, aſking their Pardon, have no Witneſſes for what they aſſert, giving too much Heed to Report; and as to Eye-witneſſes, that can be depended upon, you can ſcarce meet with any. I have enquired myſelf, and my Friends have done the ſame, both by word of Mouth and Letters, of a great many Perſons who have lived long in Eaſtern Countries, and well ſkilled in Phyſicks, but never met with one who could affirm any thing certain upon this Subject, and the greateſt Part of them condemn whatever has been ſaid or wrote concerning the Oriental Amber, as falſe or very uncertain. And the Name of *Ambarum* or *Ambra*, which has been common a long while amongſt moſt Nations to Amber, and a precious fragrant

grant *Oriental Bitumen Amber-greaſe*, has led a great many into a Miſtake, taking for *Amber* the *Ambra*, which they had heard grew in ſome Parts of *Africa*, *Aſia* or *America*. Unleſs another Miſtake has given Riſe to *Amber's* being an Oriental Production, *viz.* the Reſine *Copal*, ſo called by the Apothecaries, and the fitteſt from its Reſemblance for counterfeiting *Amber*.

Nor is *Amber* produced in all the Countries of *Europe*, which are mentioned for it, that of its being found about the *Po*, in the *Adriatick-Sea*, and other Parts of *Italy*, being only mere empty Fictions of Authors. Neither are the Proofs of *Spaniſh*, *Britiſh*, or *Hungarian Amber*, more certain than the former; and the *Gagates* ſeems to have impoſed upon Writers by the Name of *Black Amber*. But it is plain from unqueſtionable Experience, that in *Poland*, *Sileſia*, and *Bohemia*, *Amber* has been dug up, though the Annals of theſe Countries make ſeldom any Mention of it. The *German Amber* however, is better atteſted and more frequently mentioned. That it is gathered upon the Sea-Shore in the *Dutch* Iſlands in *Holſtein Jutland*, as alſo on the Banks of the Rivers, and even dug out of the Bowels of the Earth too, is atteſted by Authors of undoubted Credit. In *Saxony*, *Miſnia*, *Eiſleben*, and *Sweden*, it has frequently been dug up; and in the Coal-Pits at *Hall*, diſcovered not long ago by the Encouragement of *Frederick* the Third, have been found ſeveral Pieces of coarſe Amber; as is atteſted by Dr. *Krug*, chief Phyſician and Counſellor, and a ſkilful Director of the Mines to his Serene Highneſs the Elector of *Brandenburgh*. Nor does the famous *Marchia* afford us leſs worthy Teſtimonies: In the laſt Century *Jodochus Wilichius* mentions a Kind of *Amber* called *Falernum*, to have been found upon the Bank of a great Lake near *Neomander*, called *Nova Colla*, about three *German* Miles diſtant from *Frankfort* upon the *Oder*; and in this Century the famous *Becman*, in the *Banks* of *Viadrum*, near *Cuſtrin*, hard by the Village of *Schaumberg*; as alſo *Elſholtius*, in a Ditch in the Iſland *Pottamenſis*, in the Reign of the great *Frederick Wilhelm*. But there is a greater Quantity of Amber on the Shores upon the *Baltick*. In *Sweden* it is frequently found thrown out upon the Bank of the Lake *Meler*, or digged up there. And in *Denmark* there has been found very fine *Amber*, in a Ditch at *Copenhagen*, and in the Inland Hills of the Iſland of *Zealand*, they mention its being got, both in pretty large Lumps, and in conſiderable Quantity. *Borrichius* too, in his Letters ſays, that in the Iſlands which border upon *Cimbria* and *Holſtein*, (*Forma Manda* of the *Romans*) near the Shores there is a great deal of *Amber* fiſhed up. But there is ſtill much greater Plenty of it in the Shores of the *Baltick*, in *Samogitia*, *Courland* and *Livonia*, ſo that the Peaſants find a good deal of it covered with the Sea-Weeds and Sands. In plowing likewiſe, and digging near the Sea, they frequently light upon it, without any farther Trouble; ſo that formerly it was ſold there at a very low Price.

But none of the maritime Provinces upon the *Baltick*, is ſo rich in Amber caſt up by the Sea, as *Pruſſia*, nor is it dug up in ſuch Quantities in any other Country; ſo that the *Electrides* of the Ancients might more juſtly be placed here than any where elſe. I have had Pieces, which were found accidentally, brought to me from *Sambia*, *Natangia*, *Hockerland* and *Pomerania*;

rania; ſome too that were diſcovered near the Towns of *Holland* and *Leibſtat*; as alſo ſome dug up in the Country of *Lithuania*, and from *Varmien* and *Elbing*. Some time ago, a Friend of mine, who was a Conſul, told me, that in the Year 1641, in a Wood called *Kerbſwald*, in the Diſtrict of *Elbing*, in a very moderate Space of Time, there was dug up ſeven hundred Pounds Weight of *Amber*; and my Friend gave me lately a very beautiful Piece, which was got in the ſame Place. I have ſome Pieces too that were found upon the Banks of the *New Lake*, and that of *Courland*, as alſo of the Rivers *Pregelas*, *Viſtula* and *Elm*. Wherefore, I make no Scruple to affirm, that *Pruſſia* is founded, as it were, upon *Amber*; eſpecially as the Fountain, which burſt out all at once, near the Town of *Barenſtein*, in the Year 1666, threw out ſuch a Quantity of *Amber*, as to increaſe the King's Revenues; which moſt certainly was tore from the Bowels of the Earth, and never had ſeen the Sea.

After *Pruſſia*, *Pomerania* comes next for producing of *Amber*, eſpecially upon the Sea Coaſt, along the Shores of the Electoral Diſtricts, and conſequently thoſe of *Oliva* and *Dantzick* to *Neria*, lately ſo called. A great deal of *Amber* is thrown out upon this Coaſt, by the Violence of the Waves, and is purchaſed of the Senate, at a reaſonable Rate, by the Amber-Workers of *Dantzick*, who have a conſiderable Profit upon it. This Treaſure is ſpread as far as the Iſland *Rugen* upon the *Baltick*; and near *Hiddenſee* I have ſeen it both gathered and dug up. Neither are the Inland Parts of *Pomerania* void of this Commodity; for the Peaſants frequently light upon it in that Country, when they are labouring the ground: So that *Pomerania* may diſpute it with *Courland* and *Samogitia* for Plenty of *Amber*.

I have ſaid before that *Pruſſia* every where produces *Amber*, but eſpecially the Shore which is ſituated in that Part which is called *Sambia*, from *Neve Tilf* to *Vrantz Vrug*, about ten *German* Miles. This Seat of *Amber* was formerly divided into ſeven Receſſes, as the *Angles* commonly term them, *viz.* *Kreeke*, *Nodums*, or *Nodems*, *Laſſnieken*, *Kuckſe*, or *Kuyck*, *Palmenick*, *Nempe*, *Shierſkeim*. *Nempe* goes, at preſent, by the Name of *Kraydepellen*, or *Crapellen*, between *Palmenig* and *Subenig*, and *Thierſkeim* more frequently by that of *Burſter*, and there are others beſides theſe now reckoned into the number. The whole Shore is ſurrounded with high Mountains, and a ſhallow Sea, at firſt three or four Fathoms deep, preſently after thirty or forty, then ſhallower again, and afterwards very deep; whence you may have a Notion of the *Flats* or *Shelves*, which render the *Sudavian* Shore, and its Sea-Port *Bruſter* infamous amongſt the Mariners. Thoſe Receſſes, ſome of which are very high, rugged and ſteep, and others riſe more gently, towards *Pillaw*, terminate in a Plain. The Ground is not firm, in ſome Places concealing Water under it in ſuch a manner, as that Men and Horſes have been ſwallowed up as in a Gulph, as they ſay. The greateſt Part of it is covered with Sand, and ſome little Spots have Herbs, *viz.* *Butter-Bur*, *Eringo* and *Bur-Dock*. Trees and Brambles are ſcarce here, but at *Bruſter* they have Woods, Part of which ſometimes ſink with a Portion of the Mountain. There are no Rocks nor Stones, except at the Roots of the

Mountains, and from their Tops flow down Water diffuſed here and there, which being collected below, form little Rivulets. In the Bowels of this Shore, whoſe Outſide we have now deſcribed, there is abundance of Minerals. Here are ſeveral Kinds of *Vitriol*; in ſome Places it has white Streaks intermixed with a black Earth; in others it reſembles melted Glaſs, laid *Stratum ſuper Stratum*, with woody Fibres ſhining through it here and there; and in others it ſeems mixed with a ſhining kind of Duſt. Beſides the Vitriol, there is an Earth mixed with Bark, of which there are whole Hills, and Wood which divides the Mountains on the Shore, a long Way in the Middle. There is likewiſe a yellow Earth, like Ockre, and a blue Clay ſpread upon the Shore at certain Diſtances. Amongſt the Stones the moſt remarkable are the *Dactyli Fidei*, diſperſed amongſt the Rocks and Sands, and dug too out of the Mountains. The Rocks near the Sea, in one Part, are very hard, and in another very brittle. I found likewiſe petrified Wood there, and Stones covered with Sea-Weed of both Kinds. I paſs over various *Luſus Naturæ*, which I obſerved there. Beſides the common Stones, this Shore diſcovers ſometimes both *Adamant* and *Jaſper*. The neighbouring Plains are extremely barren; the Woods are very rare, and no Pines. I muſt add, however, that there are Herds of Seals frequently ſeen baſking themſelves, and playing together upon the Rocks and Shelves, or Sand-Banks near the Shore.

Upon this Shore there is *Amber* found amongſt the Sands and Stones, but it does not appear that it is bred there, far leſs that it is produced from the Sea-Weed, although little Pieces are often wrapt up in it, when it is thrown out upon the Shore. And though it is found every where in the Bowels of the Mountains upon the Shore, blended, as it were, with the *Cryſtals* of the *Vitriol*, with the yellow Earth, with the Sand, and the blue Clay, yet we are not to imagine that it is generated from theſe. What is found in the Vitriol, yellow Earth and Sand, is but ſeldom met with, is always very ſmall, and of very little Value. That which is got out of the blue Clay, is not ſufficiently proved yet, being ſo difficult to come at, although the Peaſants tell you of a great deal of very fine Amber found in it; and having broke a Bit of the Clay, I could obſerve the Fœtus of the Amber, ſo to ſpeak, wrapt up in a thin ſhining Bark, of a deep yellow Colour, which I ſtill keep in my *Muſæum*, amongſt the valuable Preſents of Amber from Nature.

But as the barky Earth and, beſides it, the Wood divides this Shore, ſo the Experience of many Years confirms, that the Wood which divides the Mountains is productive of Amber. And its Courſe the Diggers ſearch out and obſerve, and always find their Account in it, as long as the Firmneſs of the Ground will allow them to purſue it. The barky Earth contains only Pieces of Amber, that are ſmall, leſs ſolid, and of an ugly Colour. But the Wood is by no means to be derived from the Trees which grow here; for ſuch prodigious large Trunks, lying flat, and ſtretching their Roots and Branches a great many Fathoms round, are not to be ſeen any where elſe. Neither is it like the Wood of Trees; becauſe there are no Signs neither of

Pith nor Bark, and there are no Divarications or Knots of the Branches, nor Stalks for Leaves. Neither is there any Change of Fibres, but they are all alike in every Part of the Trunk; not to mention that it appears of a woody Structure, but not to have grown in round Layers of Fibres, but rather plain.

But your *Connoiſſeurs* have, long ago, left off admiring ſubterraneous Woods, after a great many different Kinds of them dug up in *Europe* were ſubmitted to their Examination. *Franciſcus Stellutus Lynceus* deſcribes a Kind of Wood, found in the Pits in the Dukedom of *Spoleto* or *Umbria*, very elegantly waved, and fit to exerciſe the Genius's of Artiſts, firſt diſcovered by Prince *S. Angeli Frederick Coſius*; and *P. Kircher* mentions the ſame. Another Kind of foſſil Wood of *Germany*, was diſcovered by the Induſtry of *D. Pillingen* in *Miſnia*, who explained the Production of it in a learned Commentary. I have a Piece of ſubterraneous Wood tranſmitted to me from *Lunenberg*, which is both more ſolid and heavy than that of *Pruſſia*. But I have been made acquainted with the Wood dug up together with the *Amber* upon the *Sudavian* Shore, and in the inner Parts of *Pruſſia*, by Letters from ſeveral Friends, which I can very well give Credit to. And *Bartholini* and *Borricheus*, whoſe Teſtimonies I make no doubt of, mention both Barks and Wood dug out of the Pits at *Copenhagen*, out of which there was got Amber in conſiderable Quantity. And a happy Omen of Succeſs is taken from the Fragments ſwimming upon the Coaſt of *Neringa*.

But of the Matrix of Amber, I have diſcovered, by Experience, theſe Beginnings or Rudiments. The little Hills here and there upon the *Sudavian* Coaſt, eſpecially at *Kraxtepellen*, which, at a Diſtance, look like Earth, when you approach nearer them, ſeem to be nothing but prodigious Heaps of Barks laid upon one another. The upper Part, being dried by the Sun, is greyiſh; and that being removed, there appears next an Earth of a pithy Blackneſs, bound together with great, ſmooth, ſhining Cruſts, and upon cutting it with a Knife, it ſeems to be only a Maſs of a great many ſoft Barks. At the Roots of theſe little Hills, there is a ſlabby Earth, faſtened with a gluey tenacious Liquor; it retains exactly the Impreſſions of the Hands and Fingers, and makes them black when you touch it. I judge this barky fat Earth of theſe little Hills, to be the Original of the foſſil Wood of *Pruſſia*; nor does this Wood differ from theſe Barks, except in Drineſs and Solidity, which makes it more compact, its Fibres thereby adhering more cloſely to one another. For theſe little Hills of Bark are produced from the moiſt tenacious Earth above-mentioned; and this, after the Sea-Water, together with other ſubterraneous Salts, has macerated and ſubdued it, the ſuperfluous Liquor being ſeparated from it, is dried by the Air or the Heat of the Sun. But thoſe Parts, whoſe Oil is either exhaled, or driven more inwards, being dried ſeparate from one another. Others again, which abound with this Glue, cohere mutually, compacted into Cruſts, and reſemble a kind of Wood, when a ſufficient Drineſs has made the Cruſts ſo cohere, as to put on a ligneous Appearance. But that both the Bark and Wood is of a bituminous Nature, not only the earthy Oil, but the Fire demonſtrates.

from the Sea-Weed, Twigs of Trees, or Sand, and is called *gathered Amber*.

That Amber again which is dug up from the Earth is called *Foſſil*; and in order to come at it, they fix a long Hook, like a Scythe, to a very long Pole, and this they ſtrike into a Vein, wherever they ſee it, in the Ridges of the Hills upon the Shore, trying if they can light any where upon the *Amber* in the Wood, and as ſoon as they have found it, they gently pare off the Wood; which being done, they take out the Piece of *Amber* and put it into a Bag, which they hang about their Necks. But digging into the Veins of the Mountains, which was unknown in former Ages, was begun firſt under the Direction of *Frederick Wilhelm*. Nor is the Shore fit for being dug into every where, but only certain Diſtricts of it, *viz. Eroſs*, *Gubnicken*, *Ekroſs*, *Dirſchkeim*, *Warnicken*, *Strobſchnec* and *Palmnig*; And wherever the woody *Matrix* appears, and there is an eaſy and ſafe Acceſs to it.

Amber, when it is firſt taken from its *Matrix*, as I have had occaſion to obſerve, by ſeeing it dug, is hard and very ſolid. It happens ſome times to be broke in digging, but then it is faulty; for ſome *Amber* is a great deal harder than other. Several Authors formerly, and even at this Day affirm, that they have ſeen *Amber* hard in one Part, and ſoft in another: But what I have ſeen of that kind did not reſemble *Amber*, neither in Smell, Taſte, nor upon being burnt; and therefore I ſuſpect it be only a *Bitumen* which happened to be dug up accidentally with the *Amber*; on which Account they have referred it to the Claſs of *Ambers*. But at that Rate both the Pitchy *Bitumen*, the Foſſile Coal, and thoſe Shreds which are found covered over with Pitch, with a great many other Bodies which are caſt out upon the Sea Shore, ought all to be reckoned under the ſame Claſs of *Ambers*. What has given Riſe to the Notion of ſoft *Amber*, is owing to the Opinion which ſome have of the Sources of a Liquid *Bitumen* in the Bottom of the Sea, which is hardened into *Amber* by Means of the Sea-Water. But thoſe who are moſtly employed about *Amber*, all of them affirm, that neither in digging nor gathering, nor drawing it up from the Sea, do they ever meet with it ſoft. I have carefully examined great Heaps of unpoliſhed *Amber*, as it comes from the *Matrix*, but never could light upon one Bit ſoft, that was able to ſtand the Trial of an Examination. It is a common Opinion, that the Difference between the Foſſile *Amber*, and that taken out of the Sea, conſiſts chiefly in the Hardneſs, Purity, and Cruſt. But they are deceived who believe this: For by lying buried ſome Time after it has been taken from its *Matrix*, it loſes both of its Hardneſs, and Colour, and a thick Cruſt grows over it; but theſe Accidents by no Means demonſtrate a Difference in the native *Ambers*. I am very well perſuaded, that the *Amber* produced in the Hills under the Sea, as well as that on thoſe upon the Shore, is good or bad according to the Quantity and Efficacy of the *Bitumen* and *Salts*.

In forming the Lumps of *Amber*, Nature ſhews a great deal of Fancy and Variety, ſo as to make them reſemble Pears, Almonds, Onions, Peas, and other Kinds of Fruit, or Outlandiſh Bodies, and theſe are called Drops by the Poliſhers of *Amber*, becauſe they are moſtly of a roundiſh Figure. But the Painting upon it when the Cruſt is taken off, is ſtill more admirable. I have ſeen a great many Pieces, that were fairly lettered; and I have one myſelf with the *Latin S* very diſtinctly writ upon it in white, and all the reſt of the Piece is yellow. Some of them expreſs roughly the *Arabian* and *Hebrew* Characters, and in others you may ſee repreſented Shrubs, Leaves, Clouds, Rubbiſh, and almoſt every Thing you can think of. I have one where there is the Picture of an old Man done as well as you could wiſh, holding a Child lying upon his Arm, which Picture done by Nature, when I firſt ſaw it, put me in Mind of little *Jeſus* in the Arms of *Simeon*.

Thoſe Things which are found concreted with *Amber*, I think deſerve likewiſe to be taken Notice of here; amongſt which the Stalks of Sea-weed, both the vaſicular and the ſlender Kind, formerly fixed to their Roots, and ſprouting out from the *Amber*, ought not to be paſſed over; as alſo ſmall Flint-Stones, with their Points ſticking out, and all the reſt quite involved in the *Amber*; ſo likewiſe Plates of Iron, Pieces of Wood, Shell-Fiſh, and various other Bodies which are found concreted with it.

But thoſe little Animals which are found buried in *Amber*, and are taken Notice of both by *Pliny* and *Martial*, require a more attentive Examination. In the *Amber* which I have by me, I can number above thirty different Species of Inſects, as Flies, Spiders, Gnats, Ants, Butterflies, Bees, Hog-lice, Moths, Weazels, Canker-worms, Beetles, and ſome of the horned and gilded Kind, whoſe Names I have forgot. Some Authors mention more perfect Animals being found buried in *Amber*, as Frogs, Lizards, and ſmall Fiſhes; but I can hardly believe it. That famous Story of *Herman*'s, of a *Frog* and a *Lizard* being buried together in *Amber*, I ſuſpect the Truth of, on ſeveral Accounts. That Fiſhes have been incloſed in *Amber* by Art, has been obſerved by former Authors. But you may diſtinguiſh thoſe Creatures which are buried in *Amber* by Nature, from thoſe which are incloſed in it by Art, thus, *viz.* thoſe which are done by Nature, lie near the Surface of the *Amber*, whereas thoſe which are done by Art are in the Middle of the Piece; for the Workers in *Amber* could not conceal the Artifice ſo well if they hollowed the *Amber* near its Surface, and ſo put the Inſects into it; becauſe the Cruſt being thin and tranſparent, would diſcover the Trick. If you obſerve the *Amber* too in which Inſects are buried to be ſolid, pure, without any Fiſſures in it, or diſtinct Cruſts, you may know that it is not the Work of Nature; for I have obſerved a thouſand Times, that the moſt Part of thoſe Pieces of *Amber* which have Inſects contained in them, cohere cortically, or are interſected with Fiſſures here and there, out of which Part of their *Exuviæ* is ſometimes expoſed externally. Neither is the Poſition or Condition of theſe Inſects always the ſame; for ſome of them are obſcured by their Poſition, others of them appear very plain, and ſome of them have a ſhining Caſt from the *Amber*. I have two Bees, a Canker-worm, and a Weazel's Neſt hid by their Poſition; the Beetle gliſtens, and ſome of the Flies ſhine. Beſides, you will ſee ſome of them appear lively, and others of them languid; nay, ſome of them as if awaking and attempting to extricate themſelves from their Bonds; and there are ſome Pieces where you can examine the whole Inſect diſtinctly.

Hence has aroſe that troubleſome Queſtion of the curious, how come Inſects to be involved in the *Amber*? Several Authors perplexed with the Difficulty of anſwering this Queſtion, will have *Amber* to be produced from the Juice of a Tree, and ſo theſe little Animals creeping upon the Trees are eaſily entangled in the *Reſins* or *Gums*. But in this Opinion they are not ſupported by Experience; for, if I am not miſtaken, there are very few Inſects, if any at all, that have hitherto been diſcovered inviſcated in this Manner in *Reſins* or *Gums*. We ſee them indeed adhering externally to theſe Subſtances, but not involved in them as they are in *Amber*. Others again have been driven to this Point to deny that they were real Inſects, but only deluſive Appearances reſembling them. But upon breaking or waſhing the *Amber*, this Opinion was refuted, evident Tokens of the Inſects ſtill remaining; for although the Force of the *Bitumen* ſo ſubdues the ſlender Bodies of theſe little Animals, that they become quite of a Piece as it were with the *Amber*, yet you may ſtill obſerve the Remains of an extraneous Body; and the Exuviæ of the Bees which I have in *Amber*, with their Bowels quite conſumed, make that evident to the Sight.

In order then to account for that Fate, which Inſects meet with in *Amber*, we muſt remember, that it is uſual for them in ſtormy Weather, or upon the Approach of Winter, to ſeek Shelter every where in Caves and Holes of the Earth, and there to lie concealed in a State of Sleep. As then ſeveral Kinds of Inſects ſhelter themſelves in thoſe Places nigh the Sea-Shore, and are obliged to remain there ſome time, or fall ſound aſleep, the *bituminous* Exhalations being collected into a Fluid, when this Liquor drops into the *Matrix* of the *Amber*, which now ſerves as a *Dormitory* for theſe little *Inſects*, it inviſcates and covers them over, and diſplays them thus contained in it. After it is become *Amber*, ſometimes thoſe little Creatures, thus confined in their *Dormitories*, happen to awake by means of the ſubterraneous Heat, or involved in the bituminous Fluid while awake; but as it is impoſſible for them to eſcape even while in this State, they are obliged to ſuffer the ſame Fate with thoſe that are aſleep, but ſo as they leave the Tokens of their having been awake, by a more lively and animated Repreſentation of their Bodies. To ſtrengthen this Opinion, the moſt part of Inſects that are found buried in *Amber*, are of that kind that retires into Caverns to ſleep. The greateſt part of them too appear languid, ſleepy, or drowſy, through the *Amber*. The more lively ones again, which ſeem as if they were ſtruggling, or expanding their Wings, in order to get away, theſe, I ſay, are a great deal rarer than the others. But I don't think, that ſuch a Vivacity as is required in Coition, is at all ſuitable to that ſubterraneous Habitation, and therefore I ſhould be very apt to ſuſpect thoſe, who ſhew Flies and Knats copulating together in *Amber*, as wanting only to put a Trick upon me.

I come now to examine a more beautiful Kind of *Amber*, containing in it little Branches or Twigs of Plants. I have a Piece with the Leaves of the *veſicular Sea-Weed* ſpread out, in ſome meaſure reſembling the Wings of an Eagle expanded, together with the Feet and Body. There is another with a Seed of the Tile Tree, and Part of a Twig of it; another contains a Huſk gaping, with the Leaves turned back, having in it four Seeds, with a middle Apex riſing up from them, the little Calix extending as far as the Surface of the *Amber*, and prominent. Another contains Moſs in it, woven in the Form of a Vault. In another there is a very ſmall Flower decayed. In another a ſmall Branch with three Leaves of the wild Roſemary, called by the *Pruſſians Korbi*; and another which is not poliſhed, has in it a large Branch of the *veſicular Sea-Weed* abovementioned. There are ſeverals of Moſs repreſenting ruined Towns. But one of the nobleſt is that, in which the white Part repreſents a Valley and little Hills covered with Moſs, but as it were by the Means of a Mirrour, the Reflection of the fiery Colour of the yellow *Amber* from that Part ſerving as a Glaſs to repreſent this beautiful Sight ſo, as that the Moſs might have a more elegant Appearance: Nor is that one to be deſpiſed of the Colour of Milk and Water, which is diſtinguiſhed by a Group of little moſſy Villages. I look upon theſe Amber Monuments of Vegetables as more to be eſteemed than thoſe of the Inſects. Thoſe Pieces with Barks of Trees, Pieces of Wood, and Shoots of Plants, are ſtill more numerous. There are Shoots of Pines, in Form of thoſe which the Ants build their Neſts with; but upon an accurate Examination, you can diſcover the Marks of the Foſſile Wood and Bark.

There are likewiſe found *Minerals* incloſed in *Amber*; very often *Vitriol*, which is eaſily diſcovered by the Taſte: Sometimes the *Marchaſite*, but more frequently *Iron*, which the Poliſheres of *Amber* complain much of, becauſe they cannot take it out without ſpoiling their Inſtruments. There is likewiſe ſomething of *Gold* and *Silver* found ſometimes in the unpoliſhed *Amber*, upon ſeparating thoſe Pieces that were adhering to one another: Nay, there are Pieces of *Amber*, which contain Drops of Water within them, in ſome of which, when it flows out, it taſtes ſaltiſh, and ſometimes inſipid; and it increaſes and decreaſes with the Moon, according to ſome People. I have one in which the Water is dried up, and another in which it remains ſtill the ſame. But whatever Parts, either of Plants or Minerals, are found incloſed in *Amber*, I imagine they have probably dropt accidentally into the *Matrix*, and ſo have been incloſed in the *bituminous* Fluid. The Manner how Drops of Water came to be incloſed in *Amber*, has ſomething ſingular in it, which I take to be this; the warm *bituminous* Exhalation ſurrounds a moiſt *Matrix*, and the Water being drove inwards, cannot be conſumed by the ſubterraneous Heat, while, upon account of the *bituminous* Fluid that ſurrounds it, it can find no Chink whereby to make its Eſcape, and therefore it muſt neceſſarly be confined in the *Amber*. There are ſome Pieces of *Amber*, where you plainly ſee the Marks of the Water attempting to get out after it was confined.

I have declared *Amber* to be of the foſſile Kind; but it is not to be ranked with *Metals*, becauſe it is neither ductile, nor can it be melted; ſo likewiſe after it has been by any means diſſolved, it loſes much of its Solidity, which is not the Caſe with *Metals*. There have been ſome who have affirmed, that they had the Art of melting *Amber*, and uniting ſeveral ſmall

Pieces into one Lump, without hurting its Solidity. But I found out this to be falſe, when I was engaged in melting of *Amber* by various Experiments; for the Force of the Salts, upon which the Solidity of the *Amber* principally depends, flies off in diſſolving it, nor is poſſible to hinder it, without adding ſomething elſe which impairs its Solidity; but if ſuch a gentle Heat as that of the animal Body could be applied and continued, I believe the Affair might be brought about. For that Ball of *Amber*, that was found in the Stomach of the Sheep, is compoſed of ſeveral ſmall ones, as you may ſee by the Marks of their joining every where remaining; which ſhews, that the Heat made uſe of by Nature, was not of the melting Kind, but very gentle, ſo as to glue them gradually together. Fuſed *Amber* with which Skeletons, and extraneous Bodies buried in *Amber* ſo much boaſted of, are done over, is a Varniſh, as my Friend Mr. *Vogeding* very well obſerves. I melted *Amber* long ago with the Heat of the Fire alone, without mixing any thing elſe with it, but I found it became more brittle, and its Colour leſs beautiful, occaſioned by the fine ſaline Particles which eſcaped, and ſtuck to the Sides of the Veſſel. But *Amber* is ſtill leſs to be referred to the Claſs of *Earths* or *Salts*, becauſe it coheres more than *Earths*, is fatter than *Salts*, and moiſter than either of them; it approaches nearer to *Bitumens* and *Sulphurs*; but its Hardneſs diſtinguiſhes it from theſe, for no Body can ſhew pure *Bitumens* or *Sulphurs* ſo hard and ſolid.

But *Amber*, on account of its Hardneſs, is placed amongſt the *Stones*, and for its Splendour amongſt the *Gems*; neither can its Brittleneſs be any Obſtruction to this; for the *Agate* is brittle, and *Gems* differ from one another in Solidity, yet ſtill are retained in the ſame Claſs. Your Poliſhers of *Amber* find it ſufficiently hard, eſpecially the white Sort, ſo as to blunt their Tools; and the ſmall Cannon and Mortar made of it by way of Toys, which bear the Force of Gun Powder, ſhew its Solidity. *Amber* too is chiefly valued according to its Hardneſs and Solidity, that which is brittle, being in no Eſteem at all. But that which properly diſtinguiſhed Amber from other Gems, eſpecially amongſt the ancients, was its attractive Quality; ſo that thoſe Bodies which had the Power of attracting, were called *Electrick*, which Term *Plato* himſelf has been at Pains to explain. But the Moderns, who have been at more Pains in making Experiments in natural Philoſophy, have found, that the Power of Attraction is common to other *Gems*, Stones, Glaſs, Bitumens, Reſins, Sulphur, Aſphaltum, and Lack. *Amber* however attracts ſtronger than other *Gems*, becauſe, upon rubbing, it ſends forth a greater Quantity of oily and tenaceous Effluvia: For that this Quality is owing to the oily Particles, I am convinced from an Experiment which I made upon two Pieces of Roſin; one of which, after the Oil was diſtilled from it, ſtill retained ſomething of its attractive Quality; but the other, after all the black Balſam was diſtilled from it, although it appeared ſhining, and as it were gloſſy, exerted nothing of an attracting Force; becauſe the firſt ſtill retained ſomething of Oil in it, while the other was quite drained of it like a Caput Mortuum. The Ancients excepted ſome Bodies which it could not attract, owing to the ſurprizing Qualities of Sympathy and Antipathy,

pathy, which however was not juſt; for I can demonſtrate both Baſil, and oily and moiſt Particles, and even Drops of Water, to be attracted by *Amber* at pleaſure, provided the Piece you make uſe of for the Purpoſe, be large enough, and well poliſhed. 'Tis a beautiful Sight, when the Effluvia entering the Water, the Drop riſes up into a Bubble, or when it jumps over to the *Amber*. But *Amber* acts by this Quality upon the human Body likewiſe; for upon tying a Bit of it about the Neck, you will perceive the Part that it touches, though it is but ſlightly, covered with a gentle Sweat. Mr. *Boyle*, formerly the Honour of *England*, the firſt learned Nation in *Europe*, told me, and affirmed it to me for a Truth, that a young Lady of Family, upon wearing a Set of large Beads, of milk white Coral about her Neck, was ſeized with a Tremor and Convulſion of her Mouth, which always came upon her whenever ſhe wore them, and went off again as ſoon as ſhe laid them aſide. But the Efficacy of *Amber* in attracting the Humours in Iſſues, has been experienced by ſome People, who uſe Peas of it for that Purpoſe.

There is a Fragrancy proper to *Amber*, ſuch as none of the *Gems* exhale; nor does any of the Aromatick Tribe ſcatter ſuch a Flavour, neither Frankincenſe, nor Myrrh, nor Camphire, nor Maſtick. You have ſomething like it from the Balls of Reſins found in the Neſts of Ants, but upon rubbing and burning them, you immediately diſcover the Difference. There is a Difference of Smell between the yellow, or fiery-coloured *Amber*, and the white; the firſt being oily, and therefore more bland, whilſt the Effluvia of the other are ſalt, and more acrid, and therefore affect the Organ of Smelling differently. Taſte likewiſe is peculiar to *Amber* amongſt the *Gems*, and this too is different, according to the different Mixture of oily and ſaline Particles; for the white is pungent to the Taſte, while the other is not ſo. It differs from moſt Gems too in the Variety of its Colours; there is none of it black, very little of it opaque, and it ſhines in the Claſs of pure pellucid Gems. Laſtly, you can hardly name one of them equal to it in Smoothneſs.

But its chief Virtue conſiſts, in its ſalutary Effects upon the animal Body, in which none of the *Gems* is able to come near it. It is wholeſome even crude, without the Aſſiſtance of Art, whether it is taken inwardly, or externally applied. The *Indians* and *Chineſe* are ſo fond of this Perfume, that they uſe it by way of Luxury. Every body knows, that Fumigations of it are ſerviceable in Catarrhs ariſing from Phlegm; and the *Amber Poliſhers* at *Koningſberg* attributed it to the alexipharmick Exhalations of the *Amber*, that they remained free of the Plague, when it was there. Certainly there is no Fumigation more efficacious againſt Contagion, than that from *Amber*; nor has it been known, that unwholeſome or peſtilential Vapours have burſt out at any Time from the Pits upon the *Sudavian* Coaſt. The white poliſhed *Amber* is of great Service in Defluxions of the Head; being tied round the Neck, it draws back the Humours. The yellow *Amber* is uſeful rubbed upon the Eyes; and in Iſſues little Balls of *Amber* are ſometimes of Service, as I obſerved before: When powdered, it is of great Uſe to promote the

Diſcharge of Urine, to propel the Stone in the Bladder; and aſſiſt in bringing down the Menſtrua, when other Circumſtances are favourable, as daily Experience teaches us. I had a Preſent of a Stone from a Lady weighing ſeveral Ounces, upwards of two Nails in Breadth, and three in Length, which had lain in the Vagina of a Country Woman for the Space of three Months, and gave her very great Pain, upon giving her white *Amber*, to the Quantity of a Spoonful, ſhe was freed from this troubleſome Gueſt, and I had her brought to me to examine her, that I might know the Caſe more thoroughly. The Powder of *Amber* too, infuſed in Wine, and afterwards boiled in a cloſe Veſſel, then the Wine drank warm, is ſerviceable in Obſtructions of Urine, the Calculus, and promoting the Menſtrua, though it is not ſo efficacious as the Powder itſelf. The white *Amber* is beſt for the above Purpoſes, becauſe the Virtue of the Salt is ſtrongeſt in it.

The reſinous *Magiſtery* of it is very wholeſome in Form of Pills, and nothing inferior to *Balſam Copaivi*, either for promoting the Diſcharge of Urine, generating Mucus, or mitigating a Gonorrhea; the ſame likewiſe is good in cephalick Plaiſters. The Reſin of it is uſeful, mixed with Diaphoreticks, and in ſtomachick Plaiſters; it is alſo of great Service againſt the Palſey, Apoplexy, Epilepſy, and in preventing Mortifications; and the Price is but ſmall. The Oil of *Amber* rubbed upon the Joints weakened by the Gout, ſtrengthens them, and has been famous both over *Europe* and *Aſia*; but by the Imprudence of Quacks has fallen into Diſgrace, becauſe they have frequently hurt their Patients, both in the Gonorrhea, Stone, and Suppreſſion of the Menſes, by giving too much of it; for the Doſe ought to be but ſmall, a Drop or two being ſufficient to ſaturate ſome Drachms of Sugar. In a cold pituitous Brain, one Drop received upon Cotton, and rubbed upon the Crown of the Head, or Sutures, cures it; or applied to the Ear, removes Noiſe and Tinkling. It reſtores Vigour to the Parts almoſt mortified with Cold, and aſſiſts in difficult Labours, as even the old Women in *Pruſſia* have obſerved, though they uſe the Powder moſtly in thoſe Caſes. The beſt Oil of *Amber* is that, which is light, free of all Empyreuma, whitiſh, ſubtile, and very fragrant. The volatile Salt of *Amber* is very much cried up againſt the Epilepſy, and other Diſeaſes of the Head ariſing from Phlegm; and it is likewiſe an excellent Diuretick. The *Eſſence* of *Amber* is the more ſubtile Portion of the Oil, and therefore it will have the ſame Effects with it; but if it is mixed with Spirit of Wine, it may be taken in larger Quantities. This is likewiſe of Service outwardly, in preventing Mortifications. The *Phlegm* too is reckoned amongſt the Claſs of Medicines by ſome, but any Virtue that it has, is owing to the Remains of the Oil and Salt in it, which, when intirely drawn off, leave it abſolutely uſeleſs, and only impregnated with ſmoaky Fumes. The *thick Oil*, which comes laſt off in diſtilling, is only uſed in cold Diſeaſes of the Joints; for it has a very fetid Empyreuma, ſo that I ſhould rather think it better to keep from it altogether, and uſe the *Colophony* inſtead of it.

I ſhall only add, that led by a juſt Analyſis of Nature in ſeparating the pure from the impure Parts, with the Help of a gentle Fire, I can unite all the Qualities of *Amber* in ſuch a Manner, as to make it a very proper Medicine both for external and internal Uſe, without hurting either its native Fragrancy, or the Efficacy of its oily and ſaline Particles. This I call the *Balſam of Amber*, in which, the more earthy fetid Particles being removed, the more pure and volatile are intimately combined together, without any thing extraneous being allowed to enter the Compoſition. Whatever can be expected from *Amber*, either crude, or prepared by Art, in what Manner you pleaſe, will be produced ſooner, ſafer, and more agreeably by my *Balſam*. Internally it may be taken conveniently in the Form of Pills, or Bolus; externally it may be applied after the Manner of the *apoplectick Balſam*, whoſe Colour it reſembles very much, to the Gums, Tongue, and Palate, in Faintings, Hyſtericks, Epilepſy, and Palſey, with very good Effect; and it may be taken ſafely by Way of preventitive, two or three Times a Week, to the Quantity of ſeven, ten, or even fifteen Grains. So likewiſe mixed with Anodynes, it is a more certain Remedy than the Oil, in certain Diſeaſes of the Genitals, Kidneys, and Bladder, as alſo againſt Noiſe in the Ears. Both *Hoffman* and *Ebmuller*, have very judiciouſly joined the Virtues of the *Peruvean Balſam*, with the Oil of *Amber*. But the *Peruvean* will make a happier Mixture with my *Balſam of Amber*, eſpecially againſt the Gonorrhea and Fluor Albus, or the Whites.

The Diſtillation of *Amber* is too well known to need here to be diſcribed. Either the Alembick or Retort may be uſed for this Purpoſe, but a great deal both of the Oil and Salt eſcapes through the Chinks, if you uſe the Alembick; for no Luting in the World is able to reſtrain their violent Force. The beſt Way then is to uſe a Retort, and if you want a Quantity of *Salt*, take the white *Amber*, if of *Oil*, take the yellow. From a Pound of *white Amber*, I have had Half an Ounce of *volatile Salt*, which you'll ſcarce get the ſame Quantity of from a Pound of the *yellow* Kind. The *Oil* too will come eaſier off and be ſweeter, if the *Amber* is ſmooth or ſhining with a thin tranſparent Cortex, than if it is rough, and has a thick Cruſt, or if you uſe the common Shavings of *Amber*; but you muſt add nothing to the *Amber*, though formerly they uſed to mix Sand and Flints with it. You muſt take Care that the Fire be very gentle, little more than a Sand Heat, and then in conſtant Order the Æthereal Portion of the Oil aſcends with the Phlegm, and is quite limpid. This then you put into a proper Veſſel, and as ſoon as the yellow Oil with the volatile Salt is come over, leave off Diſtilling.

By perſiſting in the Operation and increaſing the Heat, you may indeed force a thick black Liquor from the *Amber*, leaving only a Caput Mortuum, black and ſhining like Colophony, by Way of Reſiduum, but then it is bereft of all the Virtue of the Oil and Salts. Of half a Pound of the white *Amber*, there remained an Ounce of this Caput Mortuum. But it is better to leave the Strength of the Colophony behind, ſeeing this is more agreeable than the fetid black Balſam. The volatile Salt, which riſes up to the Beak of the Veſſel, or adhered to its Sides, muſt be waſhed with warm Water, and in order to ſeparate the oily Particles from it, the Solution muſt be filtered thro' wet Paper, through which the Salt paſſing leaves the Oil behind. The Solution being filtered, the Water muſt be evaporated, ſo as to leave only a third Part, which being expoſed to the cold Air, there will be formed Cryſtals of a particular Kind, reſembling Millet-Seed, or ſmall Hail-ſtones. There is another Method too of depurating the Salt, by putting the Liquor into a Glaſs with a long Neck, and expoſing it to a Sand Heat. For the white Flakes or Spiculæ, flying up to the Top of the Veſſel, the groſſer feculent Parts remain in the Bottom; but this Operation is attended with the Loſs both of the Veſſel and Part of the Salts. Some People are anxious to ſeparate the Phlegm, but it is better to mix it with Water, which imbibes the volatile Salt, in order to deprive it likewiſe of its Salt; neither will a repeated Diſtillation communicate any Virtue to it, unleſs it receives it from the volatile Salt, nor is the Flavour of the Phlegm grateful, ſo as it can be recommended for preſerving that Salt.

From Half a Pound of white Phlegm, I drew off Half an Ounce, which taſted of Salt of *Amber*, but upon repeating the Diſtillation, it taſted of nothing but Smoak, and ſmelt very diſagreeably. In the Calaphony, when it is not quite burnt, there is concealed ſomething of Salt; which you can extract by macerating it ſome Time in warm Water. This by ſome is called the *Fixed Salt* of *Amber*, but improperly, becauſe it has the ſame Virtue with the volatile, the ſame Taſte and Smell. But whatever Kind of Salt this is, the Virtues of the Colophony depends chiefly upon it. As to the Oil, there is no need of another Operation for depurating it, provided you change the Receiver at a proper Time, and the Diſtillation is right carried on, you will have it very pure at once. The Qualities of the *Oil* of *Amber* are derived chiefly from *Bitumen*, or *Oil* of the *Earth*, in which Opinion I agree with *Ol. Borrichius*, but that all the Virtues of the *Oil* of *Amber* are common to the *Petroleum*, in this I differ from him, for both the Smell and Taſte ſhew them to be different. But the Smell of the Oil diſtilled from the Foſſile Wood, agrees with the Oleum Petre, and not with the Oil of *Amber*, and I believe the Difference between theſe two Oils to be owing to the intimate Combination of the Salts with the Oil of *Amber*. What Kind of Salts theſe are I cannot determine, but they muſt be of the ſame Sort with thoſe which produce the volatile Salt of *Amber*; for there is no *Amber* of whatever Colour, that is without a volatile Salt, upon which its particular Fragrance depends; and the more it abounds with Salt, the more fragrant you will find it when it is rubbed. But though it is raſh to attempt to explain the Secrets of Nature, yet I will take it upon me to affirm, that the Salt of *Amber* is compoſed moſtly of the vitriol of Iron; for in the white *Amber* which abounds with volatile Salt, you can evidently diſcover the Chalcanthum both in the Smell and Taſte. But I don't at all attribute the *Sal Succini* to common Vitriol, for it is neceſſary that the Vitriol ſhould be conſiderably altered, to produce a volatile Salt of ſuch ſingular Efficacy. But that the *Pruſſian* Vitriol is of a different Nature from the Chalcanthum or red Vitriol of other Countries, will appear below from its Analyſis.

That this volatile Salt is produced originally from an Acid, its Taſte which is acid, and not unpleaſant neither, but almoſt vinous, declares. This grateful Acidity of the volatile Salt of *Amber* brings it near to the Spirit of Vitriol of the Philoſophers; it is pungent, not at all corroding, and upon pouring Spirit of Vitriol upon it neither efferveſces, nor is waſted, but being mixed with the Spirit of Sal Armoniac, it raiſes a great many Air Bubbles, and is abſorbed with a hiſſing Noiſe. This ſubtle, grateful, and volatile Acidity of the Salt of *Amber*, I attribute to the Influence of the Bituminous Exhalations; in the ſame manner as Spirits of Wine mixed with thoſe of Nitre or of Salt, renders them ſo mild, that they are even called ſweet. For while the ſubterraneous Heat collects the diſperſed Particles of Bitumen together, theſe Particles muſt paſs through the Apartments of the Vitriol, and in paſſing through theſe will carry along with them more or leſs of the ſubtile Effluvia raiſed by the ſame Heat from the Vitriol, and convey them to the *Woody Matrix*, where mixing their Seeds together as it were, they produce *Amber* for their Offspring.

The reducing *Amber* to a Powder is an eaſier Operation again; and indeed it is no great Matter whether you do it by beating it in a Mortar only, or grinding it afterwards upon a Marble; for it will do either Way, as we may learn from the Brutes themſelves, who devour little Pieces of it greedily, as I before obſerved. However, as reducing it to a Powder will make it mix more eaſily with the Animal Juices, it will be right to prepare it in that Way before we give it. I ſhould paſs over the Infuſion and Decoction of *Amber*, if theſe Preparations of it did not juſtly claim a Place from their being ſo eaſily made. It is certain that *Amber* yields its Virtues to Wine by boiling; nay, even by Infuſion or Digeſtiion, you can have a medicated Wine of *Amber*. The Eſſence or Tincture is prepared by pouring Spirit of Wine upon the *Amber*; but that which is made with the pure white *Amber* is not tinged yellow. Whether the Spirit of Wine ought to be ſtrong or weak for this Purpoſe, is I think doubtful, becauſe the oily Particles of the *Amber* require a ſtrong Spirit to extract them, and the ſaline ones a weak Spirit: But *Amber* yields to them both, and as after ſtanding in Digeſtion for ſome Time, the Spirit of Wine is rendered at laſt more diluted, I think therefore that the ſtronger ought to be preferred. You will have a better Tincture, if you infuſe the thin Shavings of *Amber* in Spirit of Wine. Some add Oil of Tartar per Deliquium, or of the fixed Salt, or ſharpen the Spirit of Wine with theſe, that the Spirit may extract a Tincture ſooner and more effectually, which is well enough judged, only the Tincture by that Means partakes of ſomething foreign. But if you want to extract the Virtues of the *Amber* quickly, and to have the Spirit entirely ſaturated with it, the beſt Way is to diſſolve the *Amber* by boiling it in a Glaſs with a long Neck; you can do it too by Digeſtion, but it requires a longer Time.

Formerly they uſed to prepare a *Magiſtery of Amber* by the Help of an Acid, which was not worth the Pains; for if you want to combine an Acid with the Powder of *Amber*, you'll do it much better by rubbing alone. The Tincture extracted with Spirit of Wine, will give a much better Magiſtery; for this is reſinous, nay the true Reſin or only Part of the *Amber* a very little changed by being intimately united with the diſtilled Spirit of Wine.

Some bruiſed Fragments of the Foſſile Wood I macerated in warm Water, the Lixive produced from it was of a ſweetiſh Taſte, with ſomething of that of Allum, or rather of Steel, and at laſt you could be ſenſible of ſomething of vitriol. But upon inſpiſſating it in order to make the Salt Cryſtallize, it had more and more of a vitriolick Taſte, and the Cryſtals had the ſame, except that at firſt they had a little of the Sweetneſs of Salt of Iron; and I obſerved the ſame again upon repeating the Operation. The Wood thus deprived of its Salt, I put into a Retort, and with a Heat ſo intenſe that the Fragments grew red within the Glaſs; I drew off all the Liquor from it, which was quite milky, like an Emulſion of Almonds, with a fine Pellicle at Top, after ſtanding ſome time, and Particles like Calx falling to the Bottom of it. It had a ſtrong, diſagreeable, ſulphureous Smell, which ſpread all over the Room, but upon putting your Noſe nigher the Liquor, you could ſmell ſomething of *Amber*, not indeed of the fragrant *Amber* itſelf, or the Oil, but of the Phlegm that remains in the Retort after Diſtillation. The Taſte likewiſe reſembled that of the Phlegm, ſmoaky from the Empyreuma, and ſomething of a ſoweriſh Saltneſs. The milky Colour of the Liquor diſappeared after awhile, leaving however the fat Palliate behind it. I diſtilled a Part of this Liquor again, to try if I could obtain any volatile Salt and purer Drops of Oil from it. But there was no volatile Salt aſcended, the oily Particles however ſwimming at Top were more ſubtile, and did not cohere as before in the Form of a Pellicle. There were likewiſe ſome fell to the Bottom like pellucid little Globes, of a fiery *Amber* Colour. A ſmall Portion of the Oil, *viz.* a few Drops from a Pound of the Liquor, entirely reſembled the Oleum Petræ both in Taſte and Smell. But the little Globules which appeared reſinous in the Bottom of the Veſſel, upon being gently ſhaken mixed with the Liquor. The limy Particles were produced from the finer earthy Portion forced upwards by the Fire.

The Wood when taken out of the Retort was of a ruſty Colour, exhaled a great deal of Sulphur, ſet on Fire burnt like Fewel, and had its Surface gently ſprinkled over with a fine red Duſt.

I expoſed it to the Fire for three Hours in a Crucible, and after it was cold it was likewiſe covered with a fine Duſt like Cinnabar: Upon holding a Candle to it, it did not catch Fire ſo readily as before, neither did it keep it long, nor burn like Fewel, but it ſmelt like golden Sulphur, and taſted like it too when it was chewed. When it was kindled it exhaled leſs Sulphur than that which was left in the Retort, and was of a brighter Luſtre. I put it afreſh into a Crucible for upwards of nine Hours, and then it could not be kindled any more, but like Earth Flax appeared white after having been burnt, and ſmelt nothing of Sulphur. The Colour of it after remaining ſo long in the Crucible, from grayiſh became partly white, and partly ſplendid; and when examined with the Help of a Microſcope, ſome Parts of it appeared formed like *Scoriæ*, ſome like *Chryſocolla*, and ſome like *Calx*. I expoſed th Wood after it was ſufficiently burnt, mixed with the *Gall of Glaſs*, to a melt ng Heat, and they eaſily run together into a Maſs, which afterwards ſhewed ittle Grains of *Regulus of Iron* diſperſed through it. But as I was trying to unite theſe little Grains by a ſtronger Heat into one Body, the Maſs melting with the Regulus, from black became ſplendid, and at laſt turned into Glaſs.

The native *Vitriol*, both that reſembling the *Earth-Flax*, and the other which melted, being rubbed with Iron, diſcovered itſelf to be combined not with Copper, but with Iron, for it leaves no Redneſs, which is a Sign of Copper behind it. The ſame is confirmed by that reſembling Earth-Flax after it is diſſolved and formed into Cryſtals; for there is a ſweetiſh and plain Taſte of Iron to be perceived in it at firſt, ſuch as you find in the Salt or Cryſtals of Iron; but not thoſe that are produced at *Goſlar*. But I firſt cleared the Solution by pouring Urine to it, and the Feaces being removed, there was collected a flaky Earth in them, and the remaining Liquor yielded Cryſtals of almoſt a *Sappharine* Colour, with very unequal Angles. But from the Solution inſpiſſated and afterwards filtrated and evaporated, there is produced a white Oil, which being put into an armed Retort, and expoſed to the Heat of a Baker's Oven not too violent, in twenty-four Hours it throws off an excellent Oil of Vitriol, ſuch as is commonly prepared in the Shops from the Oil of Steel. I could diſcover, by the Help of a Microſcope, a great deal of that Oil ſtill concealed in the Colcothar, whence it appears how you are to underſtand Oils being regenerated in Colcothar expoſed to the Air.

That the *Cortical Earth* is of the ſame Nature with the Foſſile Wood, appeared from examining it by the Help of the Fire. It required to be gently toaſted, before I could extract any Thing metallick out of it, although what I did get at laſt, was but very ſmall. From the *Blue Clay* ſome time ago by Diſtilling, I obtained a volatile Spirit that had the Smell of Sulphur and ſomething of Bitumen ſwimming at Top. But the yellow Earth I ſaid before inclined to Iron with ſomething of Vitriol too, as is manifeſt both from its Taſte and Smell.

This Treaſure of *Amber* was formerly laid up in the royal Treaſury by the *Kings*, who held the Grounds which produce it, of the *Amber-Gatherers*, that they might equal other Princes in their Munificence. *Solinus*, King of *Germany* (here *Pruſſia* is to be underſtood, for *Germany* was never ſo productive of *Amber*) ſent a Preſent of thirteen thouſand Pound Weight of it to *Nero*, not gathered in one Year, but collected in a great many. It was appropriated to the *Regalia* of the Order of the *Crucigeri*, the Biſhop of *Sambia* being allowed to have ſome Share in it, and it was gathered by publick Authority, with ſevere Laws againſt thoſe who ſhould ſteal or embezzle it. When the States revolted, the Revenue of *Amber* being thereby very much leſſened, the Treaſury of the above Order was conſiderably hurt by it, though they did all that they could to get the entire Poſſeſſion of it. After the *Crucigeri*, the Dukes of *Pruſſia* were at a vaſt deal of Pains to ſeparate the *Amber* from the Revenue. The Annals of that Country give a better Account of the Affair, than I can pretend to do here: They mention the Peaſants upon the *Sudavian* Shore being appointed for this Office, to which were added others out of the Diſtricts of *Schagen* and *Fiſchauſen*.

They have no ſet Days for working, but whenever they obſerve a proper Time for gathering it, they keep to it Night and Day, in Winter as well as in Summer. They have a Salary allowed them, a Houſe with a little Farm, and are free from all Taxes, and have a Meaſure of Salt for every Meaſure of *Amber* which they gather or fiſh up; and for the Overplus of the *foſſile Amber*, they are paid in ready Money. The *Crucigeri* called him who had the Overſeeing of the *Amber*, the Lord of the *Amber*; and in ſome Places that Care fell likewiſe upon the Commanders. Under *Albert* they were called more frequently Maſters, and afterwards Lord Chamberlains, being always Knights. At preſent the Governor of the Diſtrict of *Fiſchauſen* takes a Part of this Office, and the Director of the **Feloni* another, together with a particular Surveyor of the Coaſt. Under the Surveyor there are Horſemen always ready to guard the Coaſt; and to thoſe are added Foot, who take it in Turns with the Horſe, and ſometimes ſupply their Place, when there is occaſion.

The *Surveyor*'s Buſineſs is to give out Orders what they are to do, to receive the *Amber*, tranſmit it to *Koningſberg*, prevent its being ſtole, to judge of what Places are diſcovered, and to preſerve inviolably the King's Right and Authority: It is his Buſineſs likewiſe to diſtribute Salt to the Peaſants. The Horſe and Foot ride and run about the Shore in the Day Time, leſt any body ſhould ſteal the *Amber*: They likewiſe obſerve the proper Seaſons, and convene the Peaſants to gather and dig the *Amber*, and receive it at their Hands. None of the Peaſants are allowed to carry home the *Amber*, but they deliver it to one of the Horſemen, or ſome other Perſon who is intruſted with it; but that which is gathered upon the Coaſt of *Pilau* and *New Neringia*, is taken off their Hands, by the Clerk of the *Felons*. If they happen, for Want of Time, to have gathered only a ſmall Quantity, they are allowed to carry it home; but then they return it next Morning with an Oath. While they are fiſhing and digging, they have a Bag tied about their Necks, into which they put the *Amber*, and whoever hides any of it about his Cloaths, is reckoned guilty of Theft. After it is received from the Peaſants, it is put into the Hands of the *Surveyor*, who lays it up in the *Amber Ware-houſe* at *Koningſberg*, and it is divided and ſold in Preſence of the *Director of the Felons*. Formerly there were ſeveral *Amber Ware-houſes* at *Lochſtet*, *Dirſchkeim*, *Memmel*, and *Germow*, and each of them had an Overſeer.

Without the Shores, whatever *Amber* is found in the Territories of the Crown, is given in to the *Governors* of theſe Diſtricts, and that in the private Funds, which cannot be lawfully claimed by ſome Maſter, muſt neceſſarly likewiſe go to the Revenue; but hitherto I don't remember, that theſe Funds have had any conſiderable Quantity of *Amber*.

The gathering of *Amber* at one Time belonged to private Perſons, for which they had an annual Allowance of ten or twelve thouſand Dollars, beſides what was allowed for the Expence of the Peaſants: But there came more Profit from it into the Treaſury, after it came not only to be gathered, but

ſold

* *Feloniorum.*

ſold by publick Authority, a certain Price being put upon each Kind of it, according to Mixture.

The unpoliſhed *Amber* is valued according to the Size and Kind of the Pieces; the capital ones *(Haubt Stuck)* weighing ſome Ounces, come the deareſt; thoſe which are fit for turning *(Dubly)* about the Size of one's Palm, are of leſs Value; and the ſmalleſt Pieces *(Krauſis)* are the leaſt valued of all; but Pieces of ſome Pounds Weight have no certain Valuation. The Purity and Fineneſs of Colour enhanſes the Value; the impure *(Diblue)* is the cheapeſt, and the *Milk-white* the deareſt.

The Merchants of *Lubeck* and *Stolpen* firſt rivalled the *Crucigeri* in the Commerce of *Amber*; and afterwards thoſe of *Dantzick* and *Koningſberg*. At preſent the Merchants of *Dantzick* have the chief Profit of it, after getting into their Hands the *Pruſſian Amber*, and the Company of *Amber-Turners* upon the Coaſt of *Neringia*. The crude *Amber* is ſold at a great Price to the eaſtern People, and the *Armenians* and *Perſians* uſed formerly to tranſport it from *Koningſberg*, to the no ſmall Profit of the Inhabitants. But the Art of turning *Amber* is ſtill more profitable, being cut into various Figures engraved, or Bodies incloſed in it, ſo as to be reckoned amongſt the moſt precious Workmanſhip. It increaſes the Value much, if it is made of one entire Piece, if the Colours of it are very fine, and the rareſt Colours of Nature are ſuperadded.

I was the firſt who adviſed them to imitate the *French* and *Italians*, who form the *Amber* very dextrouſly into Figures of Things and Animals; and it would have ſucceeded, had the Sovereign given Orders about it, and they had the Liberty of picking out the checquered and moſaick Pieces which are fit for the Purpoſe; for opaque Colours which are propereſt for that, rarely occur in *Amber*. And not only the Art of *Turning*, but that of *Pharmacy* might be improved and enriched by *Amber*, ſeeing your itinerant Quacks get ſo much Money by adulterated Oils and Balſams of *Amber*. Beſides, it is of very great Uſe in *varniſhing*, and nothing inferior to *Lac*, if rightly prepared. The Dyers of Skins too, eſpecially the *Jews* and *Ruſſians*, make Uſe of it; ſo that from this Branch likewiſe the Value of *Amber* may be enhanced.

An odd ſort of Amber, *by* M. Hevelius n.64.p.206.

LXV. I lately received from one that liveth on the ſide of the *Baltick Sea*, a Piece of *Amber*, which is ſo ſoft that I printed my Seal on it. It is *yellowiſh* as moſt *Amber* is, tranſparent and burning as other *Amber*, but its Scent ſtronger, as if it were a kind of glutinous *Bitumen*; and yet it hath been caſt up from the Sea this Year, and was found among other Pieces. A very credible Perſon related at the ſame time, that he had been Maſter of a ſmall Piece of *Amber*, ſoft on one ſide, and very hard on the other, wherein lay buried a Fly.

n.66.p.2023

That Kind of *Amber*, which yields to the Impreſſion of a Seal, is deſervedly reckoned amongſt the rareſt of all found with us; for except thoſe two Pieces which I have got by me, I have never in all my Life ſeen the leaſt Bit of it, though I have been ſearching after it very aſſiduouſly for a great many Years bypaſt; and I queſtion very much, if ever I ſhall be able to find a Piece of it, that is ſoft on one Side, and very hard on the other.

White Amber; by Mr. Kirby. *n.*83. *p.*4052. *Vid. Sup. Cap.* II. § XXIII.

LXVI. The chief Fiſher upon the *Inland Poiſonous Sea* near *Dantzick*, informed me, that 2 or 3 Years ago fiſhing in this Sea, his Net brought up a conſiderable large Piece of *white Amber*, which was a Rarity he preſented to one of the chief Fathers of the *Olives* Abby, to which the Sea belongs. Now ſince this Sea lies high, and about 3 *German Miles* diſtant from the Ocean; and ſince alſo the neighbouring Woods, that bear none but highly reſinous Trees, cannot be reaſonably ſaid to furniſh ſuch *Amber*, that Conjecture, which imports that *Amber* is a *Bituminous Fluid Subſtance*, hardened by the *Aqua-aerial* Particles upon it, may receive ſome Confirmation from this Account.

The Electrical Power of Stones, in relation to a Vegetable Roſin; by Dr. Liſter. *n.*110. *p.*224.

LXVII. Having Occaſion in *July* 1674, to view certain Foſſils, (which I had diſpoſed into divers Drawers in a Cabinet made of *Barbadoes Cedar*, I obſerved many of the Stones in every Drawer, and ſome were lapped up in Papers) to be thick covered over with a liquid Roſin, like *Venus Turpentine*; though after diligent Search, there appeared no manner of Exudation in any Part of the Cabinet.

Of the many ſorts of Stones I there had, divers eſcaped, but not any of the *Hæmatites* kind; having therein *Manganes*, *Sciſtos*, *Botryades*, &c. which were all deeply concerned, and amongſt perhaps 500 Pieces of the *Aſtroites* here and there one or two in an Apartment, and ſometimes more were ſeized, and the reſt dry; as it fares with People in the time of the Plague in one and the ſame Houſe. I farther obſerved that Stones of a ſoft and open Grain, as well as thoſe of a hard and poliſhed Superficies, were concerned in a manner alike.

It is certain, that the whole Body of the *Turpentine* of the *Cedar-Wood* was carried forth into the Air, and floating therein, was again condenſed into its own proper Form upon theſe Stones. This makes it more than probable, that odoriferous Bodies emit and ſpend their very Subſtance. Thus *Camphire* is ſaid, if not well ſecured, totally to fly away. Again, it is hence evident, that there is great Difference betwixt the Diſtillation of Vegetable Juices, and the Emiſſion of Effluviums, or this natural Diſtillation: That really ſeparating and dividing the Subſtance into different Parts; but this carrying out the whole entirely and unaltered in its Nature.

A Catalogue of Electrical Bodies; by Dr. R. Plot, *n.*245. *p.*384.

LXVIII. Not only *Amber* and the *Agate Stone* attract ſmall Bodies, but alſo the *Adamant*, *Sapphire*, *Carbuncle*, *the Iris Gem*, *the Opal*, *Amethyſt*, *the falſe Diamond*, *Briſtol-Stone*, *Beryl and Cryſtal*; ſo likewiſe the *Jacinth*, *Granate*, *the Bohemian Stone*, *Glaſs*, *and Preparations of Glaſs and Cryſtal*; *falſe Gems*, *Glaſs of Antimony and Lead*, *all the Bitumens of the Pits*, *the Lynx-Stone*, *Sulphur*, *Maſtick*, *Sealing-Wax of Gum Lac*, *hard Roſin*, *Arſenick*, but weakly, and in dry Weather *Sal-Gem*, *Talk*, and *Roch-Allum*.

Ambergreece a Vegteable Production, By . . communicated by R. Boyle, *n.* 97. *p.* 6113.

LXIX. 1. The ſeveral Trials and Obſervations of my own about *Ambergreece* having long kept me from acquieſcing either in the vulgar Opinions, or thoſe of ſome learned Men concerning it; yet I confeſs, my Experiments did much leſs diſcover what it is, than the following Paper has done, in caſe we may ſafely and intirely give Credit to its *Information*, and that it reach to all kinds of *Ambergreece*. And probably you will be invited to look upon this Account, tho' not as compleat, yet as very ſincere, and on that ſcore credible, if you conſider, that this was not written by a *Philoſopher* to broach a Paradox, or ſerve an Hypotheſis, but by a *Merchant* or *Factor* for his Superiors, to give them an Account of a Matter of Fact; and that this Paſſage is extant in an *Authentick Journal*, wherein the Affairs of the *Dutch* and *India Company* were by publick Order from time to time regiſtered at their chief Colony *Batavia*, which was lately taken in a *Dutch Eaſt-Indian Prize*. And it appears by the Paper itſelf, that the Relation was not looked upon as a doubtful thing, but as a thing from which a practical Way may be deduced to make this Diſcovery eaſily *Lucriferous* to the *Dutch Company*.

" *Ambergreece* (ſays the Journaliſt, *Mar.* 1. 1672.) *is not the Scum or Excrement of the Whale, &c. but it iſſues out of the Root of a Tree, which Tree how far ſoever it ſtands on the Land, always ſhoots forth its Roots towards the Sea, ſeeking the Warmth of it, thereby to deliver the fatteſt Gum that comes out of it: Which Tree otherwiſe by its copious Fateneſs might be burnt and deſtroyed. Where-ever that fat Gum is ſhot into the Sea, it is ſo tough, that it is not eaſily broken from the Root, unleſs its own Weight, and the Working of the warm Sea doth it, and it floats on the Sea.*

" *There was found by a Soldier* ¼ *of a Pound, and by the Chief, two Pieces weighing* 5 *Pounds. If you plant the Trees where the Stream ſets to the Shore, then the Stream will caſt it up to a great Advantage.*"

An Animal Production, by Mr. Rob. Tredway, *n.* 232. *p.* 711.

2. An ignorant Fellow in *Jamaica*, about two Years ago, found 150 Pound Weight of *Ambergreece* daſhed on the Shore, at a Place in theſe Parts called *Ambergreece-Point*, where the *Spaniards* come uſually once a Year to look for it. This vaſt Quantity was divided into two Parts; ſuppoſed by Rolling and Tumbling in the Sea. This Man tells me, that it is produced from a Creature, as Honey or Silk, And I ſaw in ſundry Places of this Body, the Beaks, Wings, and Part of the Body of the Creature, which I preſerved ſome time by me. He adds, That he has ſeen the Creatures alive, and believes they ſwarm as Bees, on the Sea-Shore, or in the Sea.

The Production of Coral, by S.P. Boccone, *n.* 99 *p.* 6158.

LXX. 1. *S. Boccone* having been preſent at the *Coral-Fiſhing*, in the Channel of *Meſſina*, which ſeparates *Calabria* from *Sicily*, relates in a Letter of his, written on that Subject to Signior *Marchetti* at *Piſa*, that before the *Coral-Fiſhers* drew their Nets out of the Water, he immerſed his Hand and Arm into the Sea, to feel whether the *Coral* was ſoft under the Water, before it was drawn up in the Air, and found it altogether hard, except the round End, which having been bruiſed with his Nails, he found it made up of 5 or 6 little Cells, full of a white and ſomewhat mucilaginous Liquor, reſembling that milky Juice, found in Summer in the long Cods of the Herb called *Fluvialis Piſtana Foliis Denticulatis*, ſpoken of by *John Bauhinus*.

This *Coralline Juice* he calls *Leven*, becauſe, having taſted it himſelf, as well as the Mariners did, they always found it of a ſharp and aſtringent Taſte, in ſuch Pieces as they came recently out of the Sea; thoſe that are dried, loſing that part of the Taſte which is acrimonious, and retaining only that which is aſtringent: Which Change of Taſte he affirms to be made in about 6 Hours after the *Coral* hath been drawn up; in which time alſo, the ſaid *Leven*, that is incloſed in the Pores is dried, and hath changed its Colour. He inclines ſtrongly to the Opinion of thoſe who conceive, that the long Concoction of the *Ferment* fixes the Parts, and produces the *red Colour*, eſpecially being near to the *hard Coral*, and the *red Vermillion*, which ſurrounds it.

By M. Guiſony, ib. p. 6159.

2. M. *Guiſony* is of Opinion, that *Coral* is ſo far from being a Plant, that it is a mere *Mineral* compoſed of much *Salt*, and a little *Earth*; and that it is formed into that Subſtance by a *Participation* of divers *Salts*, that enſues upon the Encounter of the *Earth* with thoſe *Salts*; after the manner of the known *Metallick Tree*, which, in a very little time, is formed, and increaſed by the Settling and Combination of *Mercury* and *Silver*, diſſolved in *Aqua Fortis*, and afterwards caſt into common Water; the Parts of this *Mineral* and *Metal* joining themſelves one to another. Which thing alſo happens in ſome *ſubterraneous Grotto's*, where, by a continual and long Fall of Water, drops many ſorts of Figures, and amongſt them Shapes of little Trees are formed. This Sentiment he confirms, by alledging, that he can ſhew a *Salt* of *Coral*, which being caſt into Water, and there diſſolved, upon the Evaporation of that Water by a gentle Heat, is preſently coagulated, and converted into ſtore of ſmall Sticks, reſembling a little Foreſt.

Trochitæ & Entrochi *deſcribed; by Dr.* Liſter, n. 100. p. 6181.

LXXI. 1. The *Stones* figured like *Plants*, which *Agricola* calls *Trochitæ*, and the compound ones *Entrochi*; we in *Engliſh*, St. *Cutberd*'s *Beads*; are (like the *Lapides Judaicai*) of an *opaque* and *dark-coloured Spar*; tho' I have of them from ſome Parts of *England*, of a *white Spar* or *Cawke*, as our Miners call it. They all break like *Flint*, poliſhed and ſhining.

Vinegar, as a *Menſtruum*, will corrrode and diſſolve them, (as well as all *Foſſils*, of what *Figures* ſoever) provided they be broken into different ſmall *Grains*; and if the Bottom of the Veſſel hinder not, they will be moved from Place to Place by it.

The Figure of the *Trochitæ* is *cylindrical:* the utmoſt *Round* or *Circle*, (we ſpeak of one ſingle Joint, which *Agricola* calls *Trochites*) is in general ſmooth, both the flat Sides are thick, drawn with fine and ſmall *Rays*, from a certain Hole in the Middle to the Circumference. Two, three, or more of theſe *Trochitæ* joined together, make up that other Stone, which is called *Entrochos*.

thus: The *Trochitæ*, or ſingle Joints, are ſo ſet together, that the Rays of the one enter into the other Furrows, as in the *Sutures* of the *Skull*. *Fig.* 93.

They are found very plentifully in the *Scars* at *Braughton* and *Stock*; little Villages in *Craven*. I never met with any much above two Inches about; others there are as ſmall as the ſmalleſt Pin, and of all *Magnitudes* betwixt thoſe Proportions. They are all broken Bodies; ſome ſhorter Pieces, ſome longer, and ſome of them indeed *Trochitæ*, that is, but ſingle Joints. I never found one intire Piece much above 2 Inches long, and that very rarely too; in ſome of which long Pieces, I have reckoned above 30 Joints. And as they are all broken Bodies, ſo are they found dejected, and lying confuſedly in the Rock; which, in ſome Places, where they are to be had, is as hard as *Marble*; in other Places ſoft and ſhelly (as they call it) that is, rotten, and periſhed with the Wet and Air. And though in ſome Places they are but ſprinkled here and there in the Rock, yet there are whole Beds of Rock of vaſt Extent, which are made up, for the moſt part, of theſe, and other figured *Stones*, as *Bivalve*, *Serpentine*, *Turbinate*, &c. as at *Braughton*.

As to the *Injuries* they have received, in their Removal from the natural Poſture, if not Place of their Growth and Formation, they are manifeſt; for, beſides their being all *broken Bodies*, we find many of them depreſſed and cruſhed, as if the Joint of a hollow Cane ſhould be trod under Foot: Theſe *Cruſhes* being alſo real *Cracks*, as of a Stone or Glaſs. Again, Theſe *Stones* *Fig.* 92. conſiſting of many *Vertebræ* or Joints, they are many of them ſtrangely *diſlocated*; ſometimes two, three, or more of the Joints in a Piece are ſlipped out of order, or rank; and ſometimes a whole Series of Joints, as when a Pack of Crown Pieces leans obliquely upon a Table. Farther, Others I have, that are twiſted like a Cord; if this poſſibly may be reckoned among the *Injuries*. Laſtly, Some have their Joints indeed even, and in file; but are yet ſtuffed with a foreign Matter, as when *Bricks* are laid in *Mortar*.

There is great Variety as to the Thickneſs of the *Trochitæ* or ſingle Joints, ſome are ſo thin, that they are ſcarce the full of the 24th Part of an Inch; others are a full quarter of an Inch thick: Of theſe latter I only found at *Stock*. Betwixt theſe Extremes, there are Joints of all Meaſures in divers Pieces; but in one and the ſame Piece, they are moſtly of an equal Thickneſs. And there are ſlender and ſmall *Entrochi*, or Pieces, which have as thick Joints as the biggeſt and faireſt Pieces.

There is alſo ſome Difference in the *Seams*, or cloſing of the Joints. Some are but ſeemingly jointed, which appears by this; that if they be eaten down a while in diſtilled *Vinegar*, the ſeeming *Sutures* will vaniſh, as in ſome I had out of *Staffordſhire*, from about *Biresford* upon the *Dove*: Others, and all here at *Braughton* and *Stock*, are really jointed, and the Sutures indented; which Indentures being from the terminating of the Rays, they are more fair or large, according to the Difference of the Rays, but even, equal, and regular.

We have ſaid that the utmoſt Circle is generally flat and ſmooth, yet are there many other Differences to be noted; very probably, becauſe they are Parts of different Species.

1. Their Joints are of different Thickneſſes.

2. On ſome *Entrochi*, betwixt Suture and Suture, in the Middle of each Joint, are certain Knots in a Circle; the Joints thus diſtinguiſhed are very deep and large, and are very frequent at *Stock*.

3. There are likewiſe of theſe, with a Circle of Knots, which have many Knots beſide on each Joint, and look rugged.

4. Some with much thinner Joints, which yet have a Circle of Knots in the Middle of each Joint; and this alſo looks as tho' it were all over knotted; and theſe are found at *Braughton* only, as far as I know.

5. As ſome have but one Circle of Knots, others are knotted all over the Joint, and rough; ſo are there ſome others, which have a Circle of larger Knots in the Middle of each Joint, and a Circle of leſſer on each ſide, cloſe adjoining to the Border or Verge of the *Suture*. This is huge pretty, and they are found at *Stock*.

6. Others betwixt Suture and Suture, in the Middle of each Joint, riſe with a circular Edge.

7. A ſmooth *Entrochos*, with a large or much riſen Edge on the Middle of one of the Joints, and a much ſmaller on the Middle of another Joint, and that alternatively.

8. The ſame alternate Difference, the Joints only much rounder and blunt, and here the Joints are viſibly one thicker than the other.

9. The ſame with alternate Edges knotted.

10. A double Edge in the Middle of every Joint: This makes the Joints look as tho' they were exceeding thin and numerous, but indeed they are not ſo.

11. A double Edge in the Middle of every Joint, knotted by Intervals, or, as it were, ſerrate Edges.

Fig. 92. Some of the Pieces of moſt, if not all, of the Differences of theſe *Entrochi* are ramous, having leſs Branches deduced from the greater, and that without Order. *Fig.* 93. Theſe Branches are deep inſerted within the Stem, and by being ſeparated, leave great Holes in the Sides of it. The Rays in the Joints of the Branches, run croſs to the Rays of the Stem. On thick Stems are ſometimes very ſmall Branches, but moſtly the bigger the Stem, the thicker the Branches. Some of theſe Branches are branched again, yet I find not any of them above one Inch entire, and yet adhering and inſerted into its Stock or Bole, and for the moſt part not above a Joint or two. The Branches are known from the Stem, by being a little crooked, and ſomething tapering or conick.

We meet but with few Pieces (beſides the Branches) that are not exactly cylindrical, ſetting aſide the *Injuries* abovementioned. And amongſt thoſe *Fig.* 94. few, ſome tapering at both Ends, and much ſwelled in the Middle; others figured like a kind of Fruit, or *Lapis Judaicus*, yet truly *Entrochi*, and jointed, ed, notwithſtanding this Shape: Upon a ſmall Stalk of two or three Joints, is ſuddenly raiſed an oval Bottom, broken off alſo at both Ends.

To theſe we ſhall add, what ſeems to have been *Summitates*, or *Faſtigia* ; *Fig.* 95. long and ſlender Pieces, with a little Button, hollow on the very Top ; which Top ſeems not to have been divided or broken off from any thing elſe.

Theſe Hollows are ſometimes filled with Earth, and ſometimes another *Entrochos* is incloſed, like a Pair of Screws ; and which is, as it were, Pith to the other.

Of theſe inward *Entrochi*, ſome I have which are tranſparent. Theſe Hollows or Piths are of different Bores, but moſt are round ; and yet there are of them in great plenty at *Stock*, whoſe Hollow in the Middle is in the elegant Faſhion of a *Cinquefoil* ; and the Rays of the Joints of theſe *Entrochi*, *Fig.* 91. are much deeper and fewer in Number, than of any other yet obſerved by me. Theſe alſo are ſmooth jointed. This is moſt ſurprizing, and I know not any Vegetable whoſe Pith is perforated in ſuch a manner.

Laſtly, We, in theſe Rocks, find certain rude *Stones* of the Bigneſs of *Walnuts*, which have many Impreſſions of *Trochitæ* upon them, as though they had *Fig.* 96, been the Roots of them. And when theſe have been a little cleanſed in *Vinegar*, 97, 98. theſe Impreſſions appear more than caſual ; for the Subſtance that covers them (if not the Stones themſelves) is Spar, and the Impreſſions are round Holes with Rays, like thoſe Holes which we ſaid above the Branches made in the Sides of the Stock, when broken out from them. I have found ſome of them moſt elegantly figured, intire and compleat at *Stock*, amongſt very many others ſtrangely ſhattered and defaced. One is in the Faſhion of a *Pine-Apple*, or *Cone*, with a hollow Bottom, about the half of an Inch deep, and as much over at the Bottom: On the very Top is the round Figure of an *Entrochos* broken off ; round about the Bottom, or Baſis, are five ſingle Feet at equal Diſtances, in the Figure of Creſcents. The Stone is incruſtate, or made up of angular Plates, *viz.* The Bottom is compoſed of 5 Plates, which we call Feet ; the Middle of the Stone of 5 other Plates, all of a *ſexangular Figure* ; and the Top, Stone. All other Plates are ſmooth on the outſide.

Another is much after the ſame pyramidal Faſhion ; the Bottom Convex, about an Inch and quarter over ; on the Top is the lively Impreſſion of an *Entrochos* broken off, or rather a *Trochites* yet remaining ; round the Baſis are 5 double Points or Feet at equal Diſtances, all broken off, and ſomewhat in the Figure of Creſcents. This Stone is alſo incruſtate, or covered with *ſexangular Plates*, which are rough.

Of theſe *figured Plates*, I find great Variety in the Rocks, broken off, and heaped together in great Confuſion, which yet manifeſtly belong to the above-deſcribed *Stones*. Some of the faireſt of them, at *Braughton* and *Stock*, are *Pentagonous*, and as broad as my Thumb-Nail, hollow on the ſide like a Diſh ; convex on the other ſide, where are certain eminent Knots about the bigneſs of a ſmall *Pin's Head*, ſet in a kind of ſquare Order : This Plate is ſomewhat thin at the Edges, and yet blunt. Others are *Pentagonous*, and ſomewhat convex above, but not hollow underneath, and without theſe eminent Knots ; the Edges as thin as of a Knife, and ſharp. Others of theſe *Penta-*

genous Plates are convex on one ſide, and ſomewhat hollow on the other, thick-edged, one of the five Sides only is indented; the indented Side is ever the thinneſt, and the Stone is moſt ſtopped towards that Side. *Note*, That there are many amongſt theſe laſt indented ſorts of Plates, which are channelled on the concave Side, and otherwiſe notched. One of theſe *Pentagonous Plates*, from *Wansford-bridge* in *Northamptonſhire*, has one of the 5 Sides thick indented; the *convex* Part has in the middle a raiſed *Umbo*, like ſome antient Shields, and round about the Sides a Liſt of ſmaller *Studs*; and ſome from *Bugthorp*, under the *Woolds* in *Yorkſhire*, are much like this.

The *Sexangular Plates* are ſmall, ſave here and there one. Some of them are a little hollow on the one Side, and *convex* on the other, having the *convex* Side moſt elegantly wrought with raiſed or emboſſed Work; that is, with an equilateral Triangle beſtriding each Corner, and a ſingle right Line in the midſt; or, if you will, two Triangles one within another. Theſe we found at *Braughton-Scar* only. Others, which are moſt common in theſe Rocks, are a little hollow on the one Side, and *convex* on the other: They are for the moſt part ſmooth on the *convex* Side, or ſcabrous only; ſome are much thicker than others, ſome being as thick as broad, but moſt are Plate-like: the Sides are very unequal, as in *Cryſtals*; ſometimes five broader Sides, and one very ſmall; again, two Sides broad, and four much narrower, and infinite other Differences as to the Inequality of Sides.

By Mr. Ray, ib. *p.* 6190. 2. 'Tis ſtrange that theſe main *Stems* ſhould be of equal Bigneſs from the Top to the Bottom, and not at all tapering, if they be indeed the Bodies of *Rock-Plants*. There are found in *Malta* certain Stones, called St. *Paul*'s *Batoons*, which, I ſuppoſe, were originally a ſort of *Rock-Plants*, like ſmall ſnagged Sticks, but without any Joints; the Trunks whereof diminiſh according to the Proportion of other Plants, after their putting forth of their *Branches*. Thoſe *Roots*, which you have obſerved, are a good Argument, that theſe Stones were originally Pieces of *Vegetables*. Who knows but there may be ſuch Bodies growing on the *ſubmarine Rocks* at this Day, and that the Fiſhers for *Coral* may find of them; tho' being of no Uſe, they neglect and caſt them away. Certain it is, there is a ſort of *Coral* jointed.

By Mr. J. Beaumont, n. 129. p. 724. 3. All the *Trochytæ* and *Entrochi*, deſcribed by Dr. *Liſter*, are found in *Mendip-Hills*, except that figured like a Fruit, and my Obſervations generally agree with his. But I may add, that I find even the Joints of ſome of thoſe *Entrochi*, which ſwell in the middle, to be of that Make: So that ſuch an *Entrochos* ſhews like a Parcel of little Barrels, ſet one on the other.

Their *Hollows* are of all *Bigneſſes*, from a *central Point*, to the taking up of more than a third part of the Stone. Some of theſe *Entrochi* are ſo hollow, that there is only a thin Shell left, ſmooth within and without; others have only a thin Shell left, but with *Screws* within and without, and ſometimes both theſe are one entire Piece, with ſeeming *Sutures*. Thoſe *Hollows*, like a *Cinquefoil*, ſeem moſt natural to the *Radix*, having 5 hollow Stirts or Feet iſſuing ſide-ways from it: And I find in ſome Pieces of *Radix's*, that a little Furrow paſſes inwardly from each Foot to the Top of the Stone, with a Ridge on the outſide of it. Beſides theſe, I have a new Species of *Trochites* and *Entrochi*, which has 6 Inlets in the Hollow, as the latter has but 5; but with this Difference, that theſe Inlets terminate in Angles, ſo that it is a *ſexangular Hollow*, whereas the *Cinquefoil* Inlets are round as the Leaf is, and not pointed, tho' I have ſeen even of theſe with ſharp Angles.

The *Rays* ſhooting from a *Center*, muſt of neceſſity leave conſiderable Wideneſſes betwixt them, as they paſs towards the Circumference, according to the Bigneſs thereof: to fill up thoſe Wideneſſes, I find that in ſome, betwixt 2 *Rays* iſſuing from the *Center*, a third *Ray* riſes about half-way on the *Stone* from the Center, and ſhoots to the Circumference. Some have their *Rays* gentle widening from the Center to the Circumference; ſome have a *Trunk* riſing from the Center, which grows forked towards the Circumference; ſometimes, betwixt thoſe Forks, there ariſes a little *Ray* near the *Trunk* where the Forks join, which ſhoots to the Circumference; (but, *Note*, That theſe Differences are ſcarce diſcernible, where the *Rays* are fine, but with the help of a Glaſs:) ſome again are *ramous*, having a *Trunk* riſing from the Center, with 3, 4, or 5 Branches ſhooting to the Circumference; ſome are ſmooth half-way on the Stone from the *Center*, and have a Circle of ſmall *Rays* near the Circumference; ſome are ſmooth without any *Rays*, theſe are commonly pretty thick, and are joined in an *Entrochos* after this manner: One *Trochite* a little within the outward Circle, in the upper and lower Parts, where the *Rays* uſe to be, has round Inlets or Sockets, pretty deep, ſo that only a thin *Tympanum* hinders, but the *Trochite* would be hollow at this Wideneſs all thro'; and in the middle of this *Tympanum* there is a Hole, as in other *Trochites*, which is ſometimes round, ſometimes like a *Cinquefoil:* The *Trochites*, that anſwer this on both Sides, have ſmooth Joints, (I cannot properly call them *Screws*, having no Ridges) which enter into theſe Sockets; thoſe Joints being hollow alſo, and ſo other *Trochites*, with Sockets, come on upon thoſe again to make up the *Entrochos*. Some of theſe have both Sockets and Rays, ſome have a Socket on the one ſide, and Rays on the other without a Socket; ſome are all ſmooth, only a ſmall Ridge runs round them a little within the outward *Circle*, which enters into a ſmall Furrow anſwering to it; ſome are all ſmooth, and joined only, *per harmoniam*, as Dr. *Liſter* calls it; ſome *Trochites* hold of an equal Thickneſs or Subſtance from the *Center* to the *Circumference*; ſome are pretty thick in the *Circumference*, and grow thinner towards the Center, ſo that they have Concavities on both ſides, to which *Convexities* in other *Trochites* anſwer; ſome hold of an equal Thickneſs half-way on the Stone from the outward *Circle*, and then grow concave toward the *Center*. I have alſo found ſome *Entrochi*, as well as *Trochites*, of an oval Figure, and their Bore is alſo oval; ſome *Trochites* of this kind have no *Rays*, but are joined together only by one Ridge, which paſſes directly along the middle of the Stone the long-way, there being a Furrow in the other anſwering to it: Theſe have alſo a ſmall Speck in the middle, making but a very little Impreſſion in the Stone, and ſeldom paſſing thro it; tho' I have of this ſort, with indifferent Holes, as the other *Trochites*, but ſuch are commonly pointed at the Ends, and not carried out with an oval Round as the others. There are ſome ſingle Joints, which are ſhaped with a *double Oval*; that is, the *Oval* in the upper Part of them ſtands clean contrary to the *Oval* in their lower Part. In ſome again, the *Ovals* do not ſtand ſo extremely oppoſite to each other; but only the *Oval* in the upper Part of the *Trocbite* ſeems a little wreſted from the direct Line of the *Oval* in the lower Part, ſo that they ſtand bend-ways to each other, like a St. *Andrew*'s Croſs: There are *Entrocbi* too made up after this manner; and I find moſt of the *Oval Entrocbi* grow crooked and twiſted.

I have one perfect *Radix*, without any Impreſſion of a *Trocbite* on it; the Top of it, indeed, is a little flat with a Hole in it, but it is withal very ſmooth without the leaſt ſign of a *Ray*; yet I find another with the *Rays* there: At the Middle of the broad End, there is another Hole juſt oppoſite to this. At the Ends of the 5 *Stirts* or *Feet*, where the *Hollows* ſhould ſhew themſelves, there grows after a very artificial manner, a pretty large Seam of the ſame Stone juſt over the Middle of the *Hollow*, from the upper Part of the *Stirt* to the lower Part of it; parting the *Hollow* in the Middle, and covering about a 3d Part of it, not that this *Seam* enters farther into the *Hollow* than the *Mouth* of it, ſo that the *Hollow* of each *Stirt* preſents itſelf with 2 Eyes: Hence it appears, that thoſe *Stirts* or *Feet* were never longer than they are, and that no Stone ever grew to them. Theſe *Fore-Seams* being very obnoxious Fig. 96. to the leaſt Injury, were broken off from Dr. *Liſter*'s. The Stone is compoſed of *Triagonal*, *Tetragonal*, *Pentagonal*, and *Hexagonal Plates*. The upper Part of the *Conical* End is wrought round with ſix large *Hexagonal Plates*, and theſe reach half-way the Stone; then follows a ſecond Round, made up of *Pentagonal Plates*, pretty large, and theſe reach almoſt to the broad Bottom, which is a little convex: the Bottom itſelf, and Feet, contain *Plates* of all Makes, Fig. 97. but moſt of them are very ſmall. This *Stone* is in Subſtance a whitiſh Opaque *Fluor*, of the ſame Nature with the *Trocbites*; it has outwardly a ruſty Coat, and is blueiſh within, like ſome *Sea-Shells*. When it was firſt found, it was full of a ſort of Aſh-colour'd griſty Clay, which is the evident material Cauſe of it, it being found in a Bed of the ſame.

I eaſily pick'd out the Clay with a Needle, ſo that it is now all hollow; the *ſhell-like* and *ſparry* Subſtance being ſcarce as thick as a Half-Crown. I have one *Sexangular Plate*, whoſe *convex Part* has on it a *Star* conſiſting of ſix emboſs'd *Rays*, which ſhoot from the Center directly to the middle Part of the Sides betwixt the Angles; and betwixt every two Rays there grows a little *Stud*, after a very elegant manner.

I find the *Trocbites* ſticking to *Rake-mold-ſtones*, and in the Crannies of Rocks, at all Depths from the Graſs to 20 Fathoms; and doubtleſs there are of them deeper. But I find them moſt plenteouſly in certain Beds of an aſh-colour'd griſty Clay, and particularly at one Place, within a Yard or two of the Fig. 94. Graſs. I found here a Fruit with them like a *Lapis Judaicus*, (though ſomewhat defaced) if not a Species thereof; it is about the Bigneſs of an *Acorn*, with *Ridges* and *Furrows* running the long-way; it differs from thoſe deſcribed by Dr. *Liſter*, being rather leſs in the Middle than at the Ends, and the *Ridges* not knotted or purl'd. It is in Subſtance a whitiſh opaque *Spar*, like the *Trocbites*, tho' (as Dr. *Liſter* ſays) ſome *Trocbites* are of a dark-coloured *Spar*;

Spar; and I find ſome of a white cawky Subſtance, and ſome have a *Tincture* of red; but theſe Differences proceed from the *Clay* of which they are made: For tho' an aſh-colour be the chief in it, yet there are ſome Veins of red in it, ſome of white, ſome of a light blue, ſome of a dark blue, *&c.* which cauſe theſe Varieties in the Stones. I find ſome *Trochites* and *Entrochi* ſhaped in a *raw Clay*, before they have attained the Conſiſtency of a *Stone*; and theſe, if laid in the Sun, become light and ſpungy like a *Pumex*. I took up there a Piece of another ſtrange *Stone* of the like *ſparry Subſtance*; it is about the bigneſs of a *Walnut*, hollow, and filled with the ſaid *Clay*: It ſomewhat reſembles a *Helmet*, the fore Part of it is ſmooth, the upper Part, which has a large Ridge in the Middle, is all wrought with little Rings, three at a place, encircled within each other. The *Stone* called *Cornu Ammonis*, ſhaped like a Ram's Horn, is very frequent in this *Clay*; the largeſt I have is 7 Inches in Length, 4 Inches in compaſs at the broad End, and 2½ at the ſmall End, the Top being broken off. Tracing its Original, I find ſome of the firſt Buddings out of it about the Bigneſs of a young Cock's Spur, and very much like it: I have ſome in raw Clay, and one growing of a white cawky Stone. They generally become at laſt a whitiſh *Spar*, and ſome milk-white, as ſome of the *Trochites* are.

There are of all intermediate Proportions between theſe two, tho' very few of any Bigneſs are to be found entire, but all broken and imperfect Pieces. And I take the ſeeming *Summitates* of Dr. *Liſter* to be only little Eſſays of Nature towards the Production of this *Stone*, the Alliance being evidently nearer, than betwixt them and the *Trochites*. The *Texture* of theſe *Stones* is thus: Some have maſſy *Spar* in their Inſides, which takes up three Parts of the *Stone*; then from the ſharp Top there grows thin flat Cells, or ſmall Pipes of *Spar*, ſet edge-ways one cloſe to the other, all round the Stone, which ſhoot towards the broad End, and appear outwardly like ſmall *Ridges* or *Seams*: And many of theſe *Pipes* running down thus after the *Stone*, ſhew their *Hollows*, ſome at one Place of it, ſome at another, and ſome not till they come to the broad End: And this is the Texture of the great *Stone*, which has *Rings* alſo, tho' ſomewhat defaced, running round it, tending likewiſe in their Growth towards the broad End, as in a *Ram's Horn*. Moſt of the leſſer *Stones* have very little *maſſy Spar* within them, and ſome have none; but appear ſomewhat hollow at the broad End, with *Cells* coming down inwardly from the Top of the *Stone*, reſembling thoſe in the *Flowers* of *Coral*, which terminate its *Branches*; and doubtleſs, if taken from their Beds in a ſeaſonable time, would yield the like *Milky Juice*: For I find in the Cells of ſome broken Pieces of theſe *Stones*, an evident *Concretion* of ſuch a milky Juice. And I may here acquaint you, that I have a Piece of *branchy Spar*, which I found on a Mine on theſe Hills, growing like *Coral*, and terminated with *Buttons* or *Flowers* like it. I find very few of the leſſer *Cornua Ammonis*, whoſe Cells do any way appear, or ſhew their Hollows outwardly, as in the great *Stone*, whoſe outward Surface is wholly made up (as I ſaid) of thoſe Cells, or thin flat Pipes, ſet cloſe the one to the other; many of which ſhew their *Hollows* at ſeveral Places in the *Stone*, whereas the Cells in the ſmaller ones appear only inwardly, having one Coat outwardly which covers them all, and this Coat in ſome is ſmooth, in others it is all wrought with little Rings like the *Helmet-Stone* before-mention'd; and ſome Out-ſides have Ridges or Rings round them, as a Ram's Horn.

Theſe Stones generally move in Vinegar, Juice of Lemons, *&c.* ſending forth Bubbles, as I find *Cawk* will very freely, and moſt of our *Mineral Stones.* This Motion ſeems to proceed from the Conteſt betwixt the *Acid Spirit* of *Vinegar*, and the *Mineral Salt*; ſo that the Spirits, by Fermentation breaking forth under the Stone, produce that Effect.

Ib. Pag. 702. *Fig.* 100. 4. After diligent ſearch, I have at laſt found a Mine, where well near all the *Entrochi*, (ſo called hitherto) or Bodies of *Rock-Plants*, grew tapering and ramous; ſome of them having Branches iſſuing from them near two Inches in Length, and other ſmall Branches iſſuing from thoſe; and upon a nearer Search, I diſcover'd an entire Plant, though ſmall, growing up after the Side of a Stone. I found alſo, that all the Clifts in ſome Mines, are made up of theſe *Stone Plants*; whereof ſome, as appears, were converted into the Nature of thoſe Limeſtone Rocks, whilſt they were in their firſt tender Growth; others being become *Spar*, compoſe Rocks of that Subſtance.

Conſidering that all the Clifts for a very large Circumference in ſome Places, are made up of theſe Plants, we may truly ſay, that there have been, and are whole Fields or Foreſts of theſe in the Earth, as there are of *Coral* in the *Red-Sea*. In the *Courſes*, (or *Loads* as ſome call them) betwixt the Clifts, I find of theſe *Plants* growing up in the griſty Clay, mentioned above, being rooted on the *Rake-mold Stones*; many of them being above a Foot in Height, and about the Bigneſs of the Stem of a Tobacco-Pipe: All I have yet ſeen of this Length, are either raw Clay, or of the Conſiſtency of a *Lime-ſtone*; and ſome of them have outwardly evident Beginnings of *Circles* and *Sutures*. The ſmall *Plant* which is entire, and the *branched Bodies* of many others, have attained their full Term of Growth; being become perfect *Spar*. If theſe had ever a Height anſwerable to their Bigneſs, (ſome of them being near three Inches about) they muſt have been much higher than thoſe before-mentioned. The Branches are all jointed, and have the ſame Bore with the Trunks, and are terminated with round and blunt Joints, but very ſmall. I find the Bores, or Hollows of ſuch as are found to be commonly filled with a milky curdled Subſtance, which probably, in their Time of Growth, was fluid, like that in *Coral*. As it cannot be doubted but many of theſe *Plants* grow on thoſe admirable *Radixes*, of which we have given an Account; and whereof I have at preſent ſome Pieces, which have a *Cinquefoil Bore* on the Top; others with the Impreſſions of *Oval* Joints there, and many other Differences: ſo I am now fully ſatisfy'd, that many of them grow from *Plain Roots*; that is, from *Plain Spar*, or *Lime-ſtone*, without any ſuch Figure, as the entire Plant does, and many other Trunks which I have noted.

Theſe *Plants* do not always grow up with one Trunk or Body, but ſometimes 5 or 6 Sprouts, near of an equal Bigneſs, ſhoot up together from the ſame Root, as it uſually happens with *Coral*. I have met with ſome of them which have only four Inlets in their Hollows, and others with ſeven.

Some have a *circular Edge* on every other Joint, the intermittent Joint being ſmooth without Edge or Knot. Some Trunks have circular Edges on the middle of every Joint; but ſo, that the firſt and fifth Edges are the higheſt, the ſecond and fourth the loweſt; the third is higher than the latter, and lower than the former; the Joints themſelves being great and ſmall accordingly, and this Order holds all along the Plant. Some Trunks have Edges according to the ſame Order, only the Edges on the ſecond and fourth Joints are round and blunt, the other three being ſharp; ſome have Edges after the ſame Order, which are all round and blunt. There are ſome Trunks wrought after the ſame Manner, only the firſt and fifth Joints have a Circle of Knots round them, the other three have Edges: Some Trunks have no Circles, nor Knots, but are only a little ſcabrous like the *Plates* which compoſe ſome Roots. But notwithſtanding theſe Diverſities of *Figures*, the Texture of their Subſtance appears to be wholly the ſame: And therefore ſince we find no Qualities, either by the Smell or Taſte, which manifeſt any ſpecifical Diſtinction; it may, perhaps, be as hard to make them out to be diſtinct Species, as to ſhew a ſpecifical Difference betwixt ſeveral Snow Bloſſoms.

Fig. 101.

The Reaſon of that ſtrange Diſorder which theſe *Plants* uſually lie in, and of thoſe Injuries they have received, perhaps may be this; whilſt they were growing, the Clay wherein they grew was ſoft as a Quagmire, theſe probably requiring ſuch a Subſtance to ſupport their Growth, as *Coral* does Sea-water. Afterwards as they began to ſettle to a ſtony Conſiſtency, and as part of the Clay became of a rocky Nature, the whole Maſs ſunk from its Poſition, and the Moiſture paſſing away, made ſome Concavities waſhing down ſome broken Pieces of thoſe Stones with it; and Lumps of Clay, and other Stones falling down through thoſe Crannies, added to their Confuſion, being very apt to be diſordered by the leaſt Concuſſion, either whilſt they were in their firſt Growth, or after they were become *Spar*, their Joints being very tenderly ſet together: And hence theſe Stones are generally found in *Leirey* Places (as they call it) that is, *Cavernous*.

Theſe rocky Plants begin their Growth from the fineſt Parts of Clay, being commonly white, ſoft, and ſmooth at firſt; and by degrees come to have Ridges, Knots, and Sutures, as they grow towards a ſtony, and ſo to a ſparry Nature.

The Pith continues ſtill ſoft and white, as the whole is at firſt; and it is continually refreſhed by the *Mineral* Steams and Moiſture, which have free Acceſs to it through the 5 hollow Stirts or Feet, in the *figured Roots*, or through the Maſs of Clay which commonly lies under the *plain Roots*. Nor can it be ſaid, but thoſe *Stone-Plants* have true Life and Growth; for ſince, in the Curioſity of their Make, they may contend with the greateſt Part of the *Vegetable* Kingdom, and are ſhaped like them, having inward Pith or Sap, and likewiſe Joints and Runnings in their Grit, and ſometimes Cells, which may very well ſupply the Place of Veins and Fibres; I know not why they may not be allowed, as proper a *Vegetation* as any Plant whatſoever.

Vid. Sup. §. LXX. 2. And though a Salt of *Carol* after Diſſolution, will upon Coagulation ſhoot into a little Grove of Plants, as it were, reſembling the Growth of *Carol*, yet this cannot diſprove its *Vegetation*; for it's well known, that all Plants may be ſo prepared, that from their Aſhes they will riſe again in their proper Species after ſuch a manner.

N. 150. p. 276. But I am inclined to the Opinion, that theſe *Rock-Plants* are *Lapides ſui generis*, and not *Parts* of *Plants* or *Animals Petrefied*. Indeed the *Figured Roots* on which theſe *Rock-Plants* ſometimes grow (as appears by the Impreſſion of *Rays* on the Tops of ſome anſwering to thoſe in the Joints of the Plants, and by the Impreſſion of *oval Joints* there) may give us ſome Suſpicion that they once belonged to an *Animal*, whether it were a Species of the *Stella Arboreſcens*, or ſome other: But the Trunks of theſe *Stone-Plants* cannot be looked upon as Parts of *Animals*, with the leaſt Shew of Probability. And I think them almoſt as hardly reducible to any known Species of *Vegetables*; conſidering that beſides the *Bores* of ſome of theſe with 4, 5, 6, and 7 Inlets in them, and beſides their admirably diverſified Jointings, ſcarce either of them to be matched in any *Vegetable*, I have by me above 20, if not 30, Species of theſe *Rock-Plants*, differing outwardly from each other in their *Joints*, *Knots* and *Sutures*, all obſerving a wonderful Regularity, and not one of them to be parallel'd by any *Vegetable* that I know of in Nature. And we cannot well imagine, how ſo many Species, diffuſed through many parts of the whole Earth, ſhould all happen to be loſt together. So that upon the whole, this ſeems to me a conſiderable Objection againſt thoſe who maintain that all figured Stones in the Earth, are Petrefactions of Plants or Animals; to which Opinion *Steno*, in his Diſſertation concerning Solids naturally contained within Solids, adheres.

The Aſtroites; By Dr. Liſter, n. 112. p. 274. LXXII. 1. I have procured a good quantity of the *Aſtroites* from *Bugthorp* and *Leppington* at the Foot of the *Yorkſhire Woolds*: At the former Place I have ſeen them dug out of a certain blue Clay on the Banks of a ſmall Rivulet, betwixt the Town and the Foot of the *Woolds*. There are plenty of them waſh'd *Fig.* 103. into the Brook; but the moſt fair and ſolid are thoſe we get out of the Clay.

The Matter and Subſtance of theſe Stones, if broken, is *Flint-like*, of a dark ſhining Politure; but much ſofter, and eaſily corroded by an *Acid Menſtruum*. *Vinegar* inded makes them creep; but a ſtronger Spirit, as of *Nitre*, toſſes them. I doubt not, but they will readily calcine, as the *Bellemnites*, to a very ſtrong and white Lime.

Theſe Stones (as we now find them) are all *Fragments*; either one ſingle Joint, or 2, 3, or more Joints ſet together, making a *Pentagonous* or five-ſided Column: I have not yet had any Piece much above one Inch long, which conſiſted of 18 Joints; but I have ſeen one Piece, ſomewhat ſhorter than the former, which had 25 Joints. Theſe laſt thin-jointed Pieces are quite of a different Make, as to all Circumſtances, from the other.

Every Joint conſiſts of 5 Angles, which are either drawn out and ſharp, and conſequently the ſides of Pieces made up of ſuch Joints are deep channell'd; (and this is the Condition of ſome of the thick-jointed Pieces, as well as of all the thin-jointed ones) or the Angles are blunt and round, and the Sides plain or very little hollowed. There are as big, and as ſmall Pieces of this ſort, as of any other more ſharp-angled.

Where the Joints are thin or deep, they are ſo equally throughout the whole Piece; yet are there ſome, but very few Pieces, which conſiſt of Joints of unequal thickneſs. Many of the thick-jointed Pieces have certain Joints a thought broader, or a very little ſtanding out at the Angles, and thereby the Joints are diſtinguiſhed into certain Conjugations of 2, 3, or more Joints: And theſe Conjugations are very obſervable in the thin-jointed Stones, and are marked out with a Set of Wyers.

The thickeſt Piece, which hath yet come to my hand, is not above one Inch and a half about, and thoſe very rare too: From which Size to that of a ſmall Pin, I have all the intermediate Proportions; and theſe ſo exceeding ſmall Pieces are as exactly ſhaped as the greateſt. Moſt Pieces, if not all, of any conſiderable length, are not ſtraight, but viſibly bent and inclining.

All the Pieces, of any ſort, are much of an equal thickneſs, or but little tapering; yet one of the ends, by reaſon of the Top-Joint, is viſibly the thickeſt.

This Top-Joint hath 5 blunt Angles, and is not hatched or engraven, or but very faintly, on the outſide. Every Joint elſe of a Piece (ſave the Top-Joint) is an *Intaglia*, and deeply engraven on both ſides alike; and will accordingly ſerve for a Seal. The middle of each Angle is hollow, and the Edges of the Angles are thick furrowed: The Terminations of theſe Hatchings are the indented Sutures, by which the Joints are ſet together; the Ridges of one Joint being alternately let into the Furrows of the other next it. The Hatchings of the flat-ſided Pieces are in circular Lines; but of the other two Species, they are ſtraight Lines, or near the matter.

In the very Center of the 5 Angles, is a ſmall Hole, conſpicuous for moſt *Fig.* 104. Joints. Note, alſo, that in the middle of each Joint, betwixt Angle and Angle, in the very Suture, is another ſuch like ſmall Pin-hole very apparent, if the Stones be firſt well ſcoured.

In the deep-jointed Pieces, juſt under the Top-Joint above deſcrib'd, are the *Fig.* 105. Veſtigia of certain Wyers rather than Branches; and ſometimes 2, 3, or more of the Joints of the Wyers yet adhering. Theſe Wyers are ever 5 in Number, *viz.* One in the middle or hollow Part betwixt Angle and Angle. Again in thin-jointed Pieces there are 5 of theſe Wyers, or a Set of them inſerted into every Conjugation of Joints; ſo that it were ſome Repreſentation of the thing, to imagine the Stalk of *Aſperula* or *Equiſetum*: Alſo I have ſeen, but that very rarely, (not in one Piece among 500) a Set of Wyers in the middle of a deep-jointed Piece. One thin-jointed Piece I have by me, where a *Wyer* of 20 Joints and upwards (and how much longer they may be, I know not) lies double within the hollow ſide, and by that Accident was preſerved in its natural Place. Farther, ſome Lumps of *Quarry* I have from the Place abovenamed, *Fig.* 106. where the Wyers, as well as the Stones themſelves, are ſeen in long Pieces. It is no wonder, that theſe Wyers are knock'd off, and but very rarely found adhering to the Stones they belong to, being very ſmall and ſlender, of a round

Figure and ſmooth-jointed, being ſet together *per Harmoniam*, and not indented Sutures. Nothing that I can think of, is ſo like theſe Wyers, as the *Antennæ* of *Lobſters*. Laſtly, Some of theſe Wyers are knotted, and others of them fairly ſubdivided or branched.

By Mr. Ray, *ib. p.* 178. 2. If you can allow the *Trochites* and *Entrochi* to have been Fragments of *Rock-Plants*, I ſee not why you ſhould make any Difficulty of admitting theſe to have been ſo too; the ſeveral *Internodia* being alike thin in both, and the *Commiſſures* not much different; only the external Figure doth not correſpond. The Wyers ſpringing out of the Furrows or Concave Angles of ſome of the *Internodia*, and incircling the Stalk like the Leaves of *Aſperulæ* or *Equiſetum*, ſeems to me to argue theſe Bodies to belong to the *Genus* of *Vegetables*; no leſs than *Coral*, *Coralline*, and the ſeveral ſorts of *Pori*, ſome of which are alſo jointed: But no *Vegetable* either of Land or Sea, that I know of, hath ſuch frequent Joints and ſhort or thin *Internodia*, and ſo they are Things of their own Kind, whoſe Species is, for ought we know, loſt. If they were *Vegetables*, I gueſs they were never ſoft, but grew upon the Rocks like *Coral*, and the other Stone-Plants, juſt as they are.

The Leaves of ſome ſort of *Equiſetum* are *jointed*, as well as the Stalk; elſe I know no Plant that hath jointed Leaves, except ſome ſort of *Ruſh-graſs*.

I have found on the Banks of the River *Tanar* in *Piedmont*, plenty of the *Fragments* of the Stalks of *Equiſetum* perfectly *Petrified*, with little or no Increaſe of Bulk, ſo exactly like the Plant, that all the *Striæ* did all along clearly appear. The Colour of theſe petrefied Stalks was white.

Lapides Judaici, by Dr. Liſter, *n.* 110, *p.* 224. *Fig.* 107. LXXIII. We have plenty of Stones called *Dactyli Idæi* and *Lapides Judaici* (for *Kind*) in the Stone-Quarries at *Newton* near *Hemeſley* and at *Hellingley* by *Malton*. There is ſome Variety in the Figure of them; but the moſt common one in theſe Rocks is after the faſhion of a *Date-Stone*, round and long about an Inch, and ſometimes longer. They are a little ſwelled in the middle, and narrow towards each end: They are channelled the length-way, and upon the Ridge knotted or purled all over with ſmall Knots, ſet in a *Quincunx Order*. The inward Subſtance is a white opaque *Sparr*, and breaks ſmooth like a *Flint*, not at all hollow in the middle, as are the *Belemnites*.

Vertues of the Oſtracites; By Dr. Cay, *n.* 250. *p.* 81. LXXIV. 1. Dr. *Home* of *Berwick* tells me, that he never uſed the *Oſtracites* to any that he knew to be troubled with a *Confirmed Stone* (being perſuaded that no Medicine can break a large Stone) but only to ſuch as were afflicted with *Gravel* or *ſmall Stones*, that ſome of his Patients were cured without evacuating any *Gravel* or *Stones* at all, that others evacuated both: That it never does its Work ſuddenly, (being not remarkably *Diuretick*) but that it rather *diſſolved* the *little Stones* than forced them. That none that he ever gave this Medicine to, however grievouſly and frequently afflicted before, have ever been troubled with *Nephritick Pains* ſince; that his manner of giving it, is in fine Powder mixed with about a third part of *Flores Chamomeli*; Doſe from *half a Dram* to *one Dram* in White-Wine: That the greateſt

Doſe is often apt to offend and nauſeate the Stomach; that he once gave it alone with a weak Infuſion of *Chamomile Flowers* in White-Wine after it, but this did not ſo well.

I can ſay little of my own Knowledge of this Medicine, having had it but a ſhort while, and not uſed it yet to any but one Gentlewoman, whoſe frequent and violent Fits of the *Gravel*, made her lead a Life uneaſy enough. I gave her this Medicine mixt with powder'd *Semina Saxifrag.* I cannot ſay, that ſince ſhe uſed this Medicine ſhe never had any returns of her Pains, but ſhe neither has them ſo violent, nor ſo frequently; and whenever ſhe is threatned with them, ſhe moſt certainly finds Eaſe by that time ſhe has taken 3 Doſes of her Powder. And ſhe has, ſince the uſe of this Medicine, voided a great many ſmall Stones. But the Reaſon perhaps why ſhe is ſtill threatned with the return of her *Nephritick Pains*, is, that ſhe has never followed her Medicine thoroughly, but upon the third Doſe, finding ſuch certain Eaſe, ſhe gives it over, till a new Fit forces her to uſe it again.

I take this Shell to be what Dr. *Liſter* calls *Oſtracites Maximus Rugoſus & Aſper.* It burns to a Lime, as other Shells do, and as the *Selenites* (though weakly) do. It yields no *Volatile Salt*, tho' I tried it in a naked Fire; nor do common Oyſter-ſhells, freſh taken and uſed, afford above half a Scruple of a Liquor ſomewhat moderately *Urinous*, from 4 Ounces of Shells. And it may be, if they were long dried and expoſed to the Weather, they would loſe even that, and yield no more *Volatile* Salt than the *Oſtracites.* I confeſs I was ſomewhat ſurprized at this Matter; ſince there are who ſay, that even the other Shells, that are commonly called petrefied, yield a *Volatile* Salt: And I had myſelf from the Shells of *Cruſtaceous Fiſhes*, (particularly of *Lobſters*) a *Volatile Salt* and a *Fœtid Oil* in no inconſiderable Quantity, even in a *Sand Furnace.* But theſe ſort of Shells differ from other Shells (as Dr. *Liſter* has exactly obſerved) in this too, *Quod in his Umbo ad Cardinem leviter roſtratus eſt, qui tamen in* Oſtreis *paulum aliter eſt.* They differ too in their *ſpecifick Gravity*, theſe being more ponderous than common *Oyſter-ſhells*, and ſomewhat near the *ſpecifick Gravity* of the *Selenites.* But indeed they differ one from another in *Gravity*, as well as from other Shells, as they partake more or leſs of a *Tocaphaceous* Subſtance that coats many of them on the inſide, and which perhaps may be ſomewhat a-kin to the *Selenites.* I have obſerved ſome ſuch Differences among the *Cornua Ammonis*, having had one or two ſmall ones from our Coal-Pits here, that had a conſiderable Mixture of the *Pyrites:* Whereas theſe that are found about *Whitby*, approach, I think, more to the Nature of the *Alum-ſtone*; and perhaps the *Cornua Ammonis* of the Ancients were found in Beds of ſomewhat yet more Valuable, ſince *Pliny* ſays they were of a Golden Colour, and were reckoned *inter Sacratiſſimas* Æthiopiæ *Gemmas.* I know *Agricola de Ortu & Cauſis Subterran. Lib.* 4. accounts for this Golden Colour, after another manner: *Cornua Ammonis, inquit, ſucco* Aluminis *infecta*, Aurei coloris *fiunt.* And I am ready enough to think there is ſome Truth not only in this Obſervation, but in what he immediately adds; *Idem inquit, & aliis quibuſdam Lapidibus accidit:* For I cannot but attribute the extraordinary Appearance of Colours in the *Peacock-Tail Coal*, to its being infected with the *Succus Aluminis*, having ſeen ſome Pieces of this pretty ſort of Coal ſhoot into true and genuine *Alum*.

I ſhall only add, concerning theſe *Shells*, that if they be *real Shells*, their being found in ſuch different Parts of the World, and at ſuch great diſtance from any Sea, may ſerve for a fair and convincing Argument of the Univerſality of the *Deluge*. And if they be not *Shells*, but only Stones formed by (what ſome People call) fanciful and ſporting Nature, we may, at leaſt, conclude thus much from it; That ſince even theſe *Luſus Naturæ*, theſe Freaks, and random Strokes of Nature, have not only a Beauty, but a real Uſe, nothing in nature is made in vain: And that many other *Foſſils* that we now contemn as Toys and Trifles, fit only for furniſhing out a *Muſæum*, may have other remarkable Virtues, that may, in time, bring even them to be taken notice of, and valued, as well as the long neglected and deſpiſed *Oſtracites*.

By Dr. Liſter, ib. p. 85.

2. The *golden Colour* is from its being a *Pyrites*, that is, Iron-ſtone. Again, all the *Conchitæ* kind, but more particularly the *Belemnitæ* and *Lapides Judaici*, were known to the Ancients for *Specificks* in *Gravel*.

Several regularly figured Stones; By Mr. Edw. Lhuyd, n. 200. p. 746.

LXXV. The *Pod-Stone*, as far as I know, is entirely new to us, extremely rare, and not unbeautiful. I call it the *Pod-Stone*, from the great Reſemblance it has to a Part of the Pod of a Lupine, or other Pulſe, only it is not hollow. The general Characters of this Stone are theſe, *viz. That its Figure for the moſt part is like that of the Part of a Pod, without any Cavity, and always more convex on one Side than on the other; and (if you except thoſe that are found accidentally poliſhed like Marble) very minutely plaited, or to ſpeak more plainly, very thick and elegantly hammered; its Surface is ſhining, as if done over with Oil; and upon breaking it, its Texture is ſtrious, almoſt like the Lynx-Stone.* Of this Stone there are a great many different Kinds, the principal of which only I ſhall deſcribe at preſent.

*Fig.*108. 1. The *Pod-Stone* reſembling Part of the Huſk of a *Kidney-Bean*, or the *Kidney-Bean Pod-Stone*. The Figure of it appears from its Name; as to its Size, it is an Inch and a half long, half an Inch broad, and hardly a quarter thick. With Regard to its Sides, one of them is a little bended like the Back of a Scythe, and the other (which is the ſharpeſt of the two) is ſtraight. One Extremity is ſhut up by an oblong Line with two Angles, but the other is not ſo. On the flat Side, the Surface is marked with ſtraight Lines, and ſomewhat rugous, of a coal-black Colour, except at each Extremity, where it becomes a little greeniſh; on the other Side it is ſpoilt by a ſtony Accretion, of a ruſty Colour. This one I found in a *Quarry* at *Whitney*, ſeven Miles from *Oxford*; but it is very rarely to be met with. I have ſome of them three or four times leſs than the above, and ſomewhat different from it in other Reſpects, which were got in a Pit at *Stunsfield* in the ſame County.

*Fig.*109. 2. The *Lupine Pod-ſtone*, ſomewhat reſembling the *Huſk* of a *Lupine*. It is frequently ſhorter than the above deſcribed Stone, but always broader:

Its Colour is uncertain, but for the moſt Part on its flat Side it is black, or blackiſh, and on the other of a ruſty Colour; but in both of them it varies, both as to Colour and Surface. On its crooked Part it is marked with little white Lines, and I don't know what Kind of Spots, which you may ſometimes obſerve in the *Toad-Stones* and *Tongue-Stones*. I have likewiſe found one or two having a Sort of Appendix growing to the oppoſite Side, where you could ſee ſome croſs Stalks, appearing as if ſomething ſince loſt, had formerly been connected to them. This Stone differs from the other, in that it is broader, and ſtraighter, and is not bended. In the Inland Parts of *England* this Stone is not very rare. I have ſeen of them in the Stone Quarry at *Garvord* in *Berkſhire*, at *Whitney* and *Charletown* in *Oxfordſhire*, at the Village of *Rance* in the County of *Northampton*, and at *Honey-Comb-Laſh* in *Wiltſhire*, &c.

There are likewiſe Stones of this Kind reſembling the Huſks of common Peas and Tares.

3. The *leſſer triangular Pod-Stone*, or the *leſſer Pod-Stone, with a Beak like that of a Cockle*. It agrees in Colour and Surface with the others, but it reſembles more a Kind of *Winkle*, or (if you pleaſe) the *ſmall Engliſh Cockle* of *Liſter*, than a *Huſk*; but both from its external and internal Appearance, it diſcovers itſelf to be of the Pod Kind. They have them at *Stunſfield*. Fig. 110.

4. The *Pod-Stone*, reſembling the Stone in the Head of the Cod-Fiſh. Fig. 111.

5. The *Gibbous*, and ſometimes *Tortous-pointed Stone*, akin to the *Pod-Stone*, with a Surface like that of *Marble*, or the *Gibbous marble Pod-Stone* for the moſt part nicely pointed. This *Pod-Stone* is more ſmooth and poliſhed than the former. On its lower Side it is ſometimes more, and ſometimes leſs gibbous, and for the moſt part of a blackiſh Colour, or elſe greeniſh, or whitiſh, *&c.* On the oppoſite Side it has added to it a Kind of ſtony Appendix, of a black reddiſh Colour, but this for the moſt part is wanting. On both Sides it ends in a ſharper Point than the former ones; and in many of them you will ſee, upon turning the gibbous Part to the Sun, the Appearance of a great many very minute Points. This Stone is found here and there in *Berkſhire* and *Oxfordſhire*; I found ſome of them in the Quarries at the Villages of *Markham*, *Garvord*, and *Stunsfield*. Fig. 112.

6. A greater Variety of the ſame Kind of Stone. Fig. 113.

7. The *Mole-wort-Stone reſembling the Pod-Stone*, or *the leaſt Kind of Pod-Stone like a Kidney Bean*. This *Mole-wort Stone* is the leaſt of all the *Pod-Stones* that I have ever yet ſeen, in a good meaſure reſembling a Grain of *Mole-wort Seed*, or a very ſmall *Kidney-Bean*. Its upper Part is rough, and may properly be called Pod-like, of a brown, or ſhining black Colour. Below it is tawny and ill ſhaped. Some of them I found at *Whitney* of a ſhinning Black, like a Beetle, but ſome I had at *Stunsfield*, both of this Colour, and of the brown. Fig. 114.

I imagine that at leaſt future Philoſophers (if not thoſe even of this Age) may ſafely call thoſe Stones which I have named *Silequaſtra*, or *Pod-like*, the Teeth and Bones of Fiſhes. Certainly, as to the *leſſer triangular Pod-like Stone*, I have ſeen ſome of that Kind very like thoſe little Bones, which are commonly known, taken from the Heads of *Cod-fiſh*.

*Fig.*115. 8. *The greater Toad-Stone, of a blackiſh red Colour, and like the Huſk of an Acorn.* Its Colour every where is a blackiſh red; as to the reſt, it agrees in every Reſpect with *Boetius*'s Figure of it. I found it in the Stone-Quarry at *Faringdon* in *Berkſhire*, but it is rarely to be met with.

*Fig.*116. 9. *The middle-ſized rotular Toad-Stone*, with a ſmall Hollow on each Side. Its Colour is paliſh, excepting in each Hollow, where it is of a ruſty Colour. I had it with the former.

*Fig.*117. 10. *The middle-ſized orbicular Toad-Stone*, or *the common Engliſh Toad-Stone.* It is three or four Times leſs than the *larger blackiſh red* one abovementioned. It varies very much in its Colour; ſometimes of a coal-black, ſometimes brown, or Liver-coloured, and ſometimes of ſome other Colour; ſometimes too I have ſeen it marked with blue Spots, and little Lines. I have one of them pretty thick, and leſs depreſſed than the reſt, of a pale or whitiſh Colour, bordered with black.

They are found here and there in the Quarries and Sand-Pits in the inland Parts of *England*; but the one mentioned above, I had in the Stone-Quarry at *Farringdon.* There are likewiſe found the *leſſer orbicular Toad-Stones*, of a flatiſh oval Figure.

*Fig.*118. 11. *The ſmalleſt ſized Toad-Stone, rugous on its convex Side.* This is found with the others in *Gloceſterſhire* and *Oxford-ſhire*, but is more rarely to be met with.

*Fig.*119. 12. *The leſſer Toad-Stone, pointed at Top like a Trochilus*, or *the Toad-Stone*, called *the Trochilus.* It is of a blewiſh black Colour, with a black Border. This I had from the Sand-Pit at *Faringdon.*

*Fig.*120. 13. *The leaſt Toad-Stone, akin to the Trochilus, with a longiſh ſtreaked Bud, or Proceſs ſtanding out from it.* This ſtreaked Proceſs is of a cheſnut Colour; the Knob has almoſt the ſame Appearance with that of the preceding one. I have frequently obſerved it in the Sand-Pit at *Faringdon.*

*Fig.*121. 14. *The Boat-like Toad-Stone, high at one End.* In the Stone-Quarries at *Marcham* and *Garvord*, and at *Faringdon* not very rare.

I muſt obſerve once for all, that all the *Toad-Stones* vary in their Colour; but the *Engliſh* for the moſt part approach to a blackiſh Brown, and Liver-Colour. It does not appear, that thoſe Stones have been found in *England* before; for the *Toad-Stones* mentioned by Mr. *Plot* in his Hiſtory of *Oxford*, does not belong to this Claſs; and thoſe of Mr. *Chriſtopher Meret* (if I remember the Thing right) were not *Stones*, but the *Teeth*, &c. of *Sturgeon*. And this was happily enough conjectured, either by himſelf, or ſomebody elſe; for thoſe *Stones*, in my Opinion, are nothing elſe than the Teeth of *Sturgeon* and other *Fiſhes*, which have put on the Appearance of *Stones* externally. In the Quarry at *Garvord*, ſeven Miles from the *Academy* (which upon account of the rare *Stones* I found there, I frequented pretty much) I
*Fig.*122. met at laſt with a Fragment of the Jaw-Bone of a Fiſh, as it appeared to me, to which three *Toad-Stones*, in the Form of a Triangle, ſtuck very cloſe. Two of them were of the leſſer orbicular Kind, and one of the leaſt. But

what we have ſaid already is ſufficient upon the *Toad-Stones*, which, if that is more agreeable, you may call for the future very juſtly the *Fiſh-Tooth Platter-Stones*.

15. *The ſmall Cock-Spur-Stone with a ſharpiſh Point.* This Stone is nothing else than a roundiſh Kind of *Fiſh-Tooth*, reſembling a *Cock-ſpur*, with a hollow Root, like the *Toad-Stone*. Theſe *Fiſh-Tooth Stones* differ like the others both in Colour, Surface and Size. They are found up and down, with the *Toad-Stones* and *Tongue-Stones*, in the Stone-Quarries in *Berkſhire*. Such of them as are found ſmooth and poliſhed like Marble, I imagine have been freed of the *Perioſteum*. *Fig.*123.

16. *The greater Cock-ſpur-Stone more deeply ſtreaked, and with the Point more obtuſe.* I have only happened to ſee two of this Kind which were found in the Quarry at *Stunsfeld*. *Fig.*124.

17. *The Leſſer or Middle Rhombus.* It is a flattiſh Kind of Stone, about the Size of a Cucumber-ſeed, and of a Rhomboidal Figure. One Side of it is more convex, and for the moſt part black; the other is more flat, and laid over with a Kind of teſtaceous Lamella, which ſhines ſurpriſingly, of a Coal-black or reddiſh black Colour. This likewiſe conſtitutes the Rhomboidal Figure of the Stone, with its Edge ſometimes gently ſloping; and which adds to the Elegance of it, it very much reſembles the poliſhed Tortoiſe Shell. Theſe I found in the Quarries at *Marcham* and *Charleton*. There are both larger and leſſer of this Kind, and ſome of them are quite of a different Figure from the Rhombus, only they reſemble it in their Subſtance and the Elegance of their Colours. *Fig.*125.

18. *The Pen-knife.* This Stone is quite different from all the reſt in its Figure. As to its Size and Colour, it agrees in ſome Meaſure with the Rhombus; but its Figure is only proper to itſelf. I have called it the *Pen-knife*, becauſe it ſomewhat reſembles the Point of a Knife. For it is a thin little Stone, having three Corners, one of which is leſs prominent than the other two. One ſide of it is quite plain and even, but the other, upon Account of its ſloping Margin, or if you pleaſe of ſome tranſverſe eminent Lines, is every where gently ſlanting. This I had along with the former at *Charleton*. Fig. 126.

19. *A gibbous Stone a-kin to the Toad-Stone:* Or, *The gibbous Toad-Stone*, as it is called. This gibbous Stone has its Name from its Appearance, for it is not like the reſt even below, but quite arched; ſo that if you ſet it upon a Plane, it admits the Light below it, and hence from its riſing Back, it is called gibbous, or hump-backed. In its gibbous Part it has a Foramen but a broad Baſis, very like that of the leſſer *Toad-ſtones*. This was found in the Sandy Stone-Quarries at *Marcham* by Mr. *John Archer*, of *Queen's-Colledge*, a very hopeful young Gentleman, who amongſt a great many other Stones has two or three of this Kind. I obſerved them afterwards in the *Sand-Pit* at *Faringdon*. Fig. 127.

The Stones hitherto deſcribed, together with a great many others which I found in the Inland Parts of *England*, I take to be the Teeth, or other little Bones of the Heads of Fiſhes. Beſides, I have obſerved a great many of their Fig. 128.

Vertebræ ſcattered up and down every where in *Gloceſterſhire*, *Berkſhire*, and *Oxfordſhire*; all which I commonly call by the general Name of

*Fig.*128. 20. *Ichthyoſpondyli*, or *Fiſh Vertebral Stones*. They are variouſly coloured according to the Places where they are found; ſome black, others brown, others of a Clay or Aſh Colour. They are no leſs variable too, both as to their Size and Figure, than the *Ichthyoſtea*, or *Fiſh-bone-Stones* above deſcribed. I have found ſome of them larger than your *Table-Men* or *Cheſs-Men*, and ſome of them ſmaller than a *Vetch-Seed*. I have ſeen them preſerved in the Sand-Pit at *Marcham*, almoſt without any Loſs of their bony Subſtance, as far as I could obſerve. Beſides, theſe Stones are very ſeldom or never found joined together like the Vertebræ of Fiſhes, which is a ſtrong Sign, in my Opinion, that they are not natural Stones formed after the Manner of ſome particular Bones. For if Nature does attempt to do the ſame Thing under Ground that ſhe does in the Sea, why might not ſhe with the ſame Pains and Dexterity with which ſhe makes a ſingle Vertebra make out a whole Skeleton?

*Fig.*129. 21. *A ſtrong Fragment of the Jaw-bone of a Fiſh*, with Toad-ſtones growing to it found at *Garvord*.

*Fig.*130. 22. A ſmall *Tongue-ſtone*, with a ſtony Fragment of the Jaw-bone growing to it, found at *Faringdon*.

n.243.p.279. *Fig.* 130, 131, 132. *Fig* 133, 134, 135, 136. *Fig.* 137. *Fig.*138.139 140, 141, 142, 143, 144, 145, 146, 147, 148.

23, 24, 25, We found near *Lhan Deilo* in *Caermarthenſhire*, 26, 27, 28, 29, on the *Severn* Shore in *Gloceſterſhire*; 30, at *Gold Cliff* in *Monmouthſhire*, and all the reſt in the Iſle of *Caldey* in *Pembrokeſhire*. The 25th, *Fig.* 132. whereof we found great Plenty, muſt doubtleſs be referred to the Sceleton of ſome flat Fiſh; the 23, and 24, I know not at all what to make of: The reſt are *Modioli*, or *Vertebræ* of Sea-Stars, for I have been long ſince fully ſatisfied, that all ſorts of *Entrochi* and *Aſteriæ* muſt be referred thither; not that I conclude that either of theſe, or any other marine terreſtrial Bodies, were ever really either Parts or *Exuviæ* of Animals; but that they bear the ſame Relation to the Sea-Stars, that *Gloſſopetræ* do to the Teeth of *Sharks*; the Foſſil-Shells to the Marine ones, &c.

n.253.p.187. *Fig.*149,150 *Fig.* 149, 150. Repreſent a *Lime-ſtone Marble*, we have lately diſcover'd in *Wales* when poliſhed. We have Plenty of it, but few Pieces exceed 6, 9, or 12 Inches Diameter, for 'tis only a Sort of *Alcyonium*, incorporated in ſeveral ſmall Blocks of the *Lime-Stone*, whereof *Fig.* 149, repreſents a Piece poliſhed perpendicularly, and *Fig.* 150. horizontally. 'Tis to me more beautiful than the *Florentine Marble*, but much more hard and ſubſtantial.

By Dr. Sloan, ib. p. 188. *N.B.* This Stone is a Sort of *Coral*, and the *Lapidis Aſtroitidis ſive Stellaris primum Genus. Boet. de Bodt*; or *Aſtroites*, *Worm. Muſ.* It grows in the Seas adjoining to *Jamaica*. It is frequently found Foſſil in *England*. I have ſome of it that will poliſh as well as *Agat*, which was many Years ſince found out by Mr. *Beaumont*.

The Giant's Cauſway in Ireland, *by Sir* R. Buckley, *n.* 299. *p.* 708.

LXXVI. 1. This Deſcription of the *Giant's Cauſway*, I received from a Scholar and a Traveller, who went on purpoſe the laſt Summer 1692, with

the

b
b
a
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C

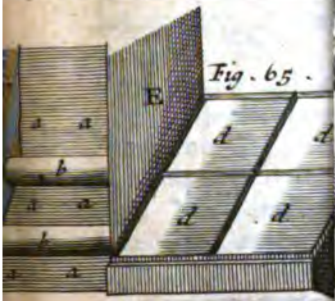
Fig. 65.
E
a a
b
a a
a a
d d
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Fig. 66.
B
B
C
C
C
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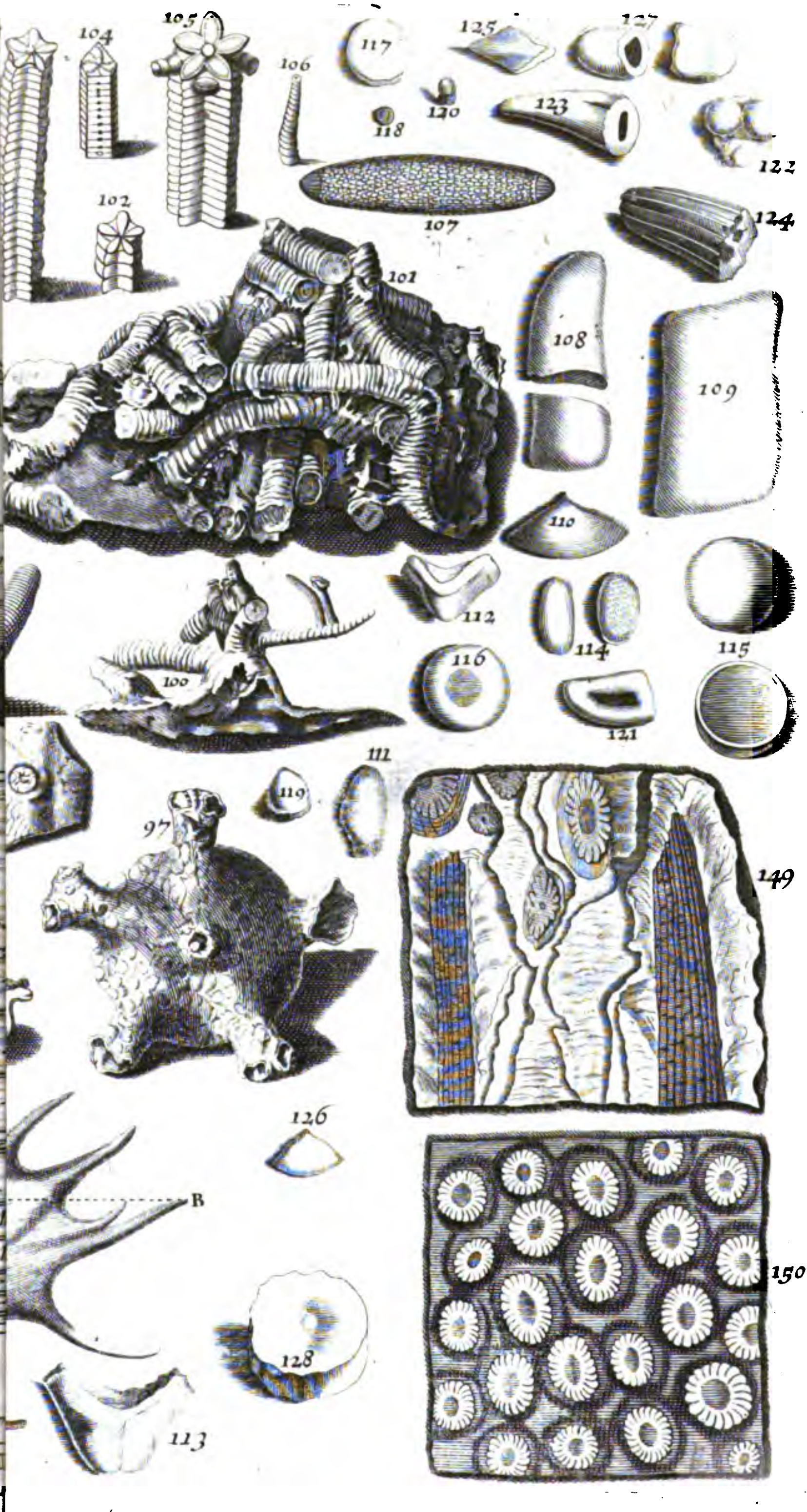
E
E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the Biſhop of *Derry* to ſee it. It is in the County of *Antrim*, about 7 Miles Eaſt of *Colrain*, and 31 Miles to the Eaſt of the Mouth of the River *Derry*. The Coaſt there is a very great Height from the Sea: And from the Foot of the Precipice, there runs out Northward into the main Ocean, a raiſed *Cauſway* of about 80 Foot broad, and about 20 Foot high above the reſt of the Strand; its Sides are perpendicular, it was about 200 Foot in view to the Sea-Water.

This whole *Cauſway* conſiſts all of Pillars of *Perpendicular Cylinders*, *Hexagons* and *Pentagons*, of about 18 and 20 Inches Diameter, but ſo juſtly ſhot one by another, that not any thing thicker than a Knife will enter between the ſides of the *Pillars*. When one walks upon the Sand below it, the ſide of this *Cauſway* has its Face all in *Angles*, the ſeveral Cylinders (pardon the Impropriety of the Word) having ſome two, ſome three of their Sides open to View. The very vaſt high Precipice does alſo conſiſt of Cylinders: tho' ſome ſhorter and ſome longer: And all the Stones that one ſees on that Coaſt, whether ſingle or in Cluſters, or that riſe up any where out of the Sand, are all *Cylinders*, tho' of ever ſo different Angles; for there are alſo Four-ſquared upon the ſame Shore.

2. The *Giant's Cauſway* is ſomewhat more than 8 *Engliſh Miles* North-Eaſt from the Town of *Colrain*, and about 3 from the *Buſh-Mills*, almoſt directly North. It runs from the bottom of an high Hill into the Sea, no Man can tell how far, but at *Low-Water* the Length of it is about 600 *Foot*, and the Breadth of it, in the broadeſt Place 240 *Foot*, in the narroweſt 120 *Foot*. It is very unequal likewiſe in the Height, in ſome Places it is about 36 Foot high from the Level of the Strand, and in other Places about 15 Foot.

By Dr. Sam. Foley, n. 212. p. 170.

It conſiſts of many thouſand Pillars, which ſtand moſt of them perpendicular to the Plain of the Horizon cloſe to one another, but we could not diſcern whether they do run down under Ground like a *Quarry* or no. Some of them are very long and higher than the reſt, others ſhort and broke; ſome for a pretty large Space of an equal Height, ſo that their Tops make an even plain Surface, many of them imperfect, crack'd and irregular, others entire, uniform and handſome, and theſe of different Shapes and Sizes. We found them almoſt all *Pentagonal* or *Hexagonal*, only we obſerved that a few had 7 ſides, and many more *Pentagons* than *Hexagons*, but they were all irregular: For none that we could obſerve had their ſides of equal Breadth; the Pillars are ſome of them 15, ſome 18 Inches, ſome 2 Foot in Diameter, none of them are one entire Stone, but every Pillar conſiſts of ſeveral Joints or Pieces, as we may call them, of which ſome are 6, ſome 12, ſome 18 Inches, ſome 2 Foot deep.

Theſe Pieces lie as cloſe upon one another as 'tis poſſible for one Stone to lie upon another; not jointing with flat Surfaces, for when you force one off the other, one of them is always Concave in the middle, the other Convex. There are many of theſe kind of Joints, which lie looſe upon ſome part of the *Cauſway*, and on the Strand, which were blown or waſhed off the Pillars. Theſe Joints are not always placed alike, for in ſome Pillars the *Convexity* is always upwards, and in others it ſtands always downwards. When you force

them

them aſunder, both the *Concave* and the *Convex* Superficies are very ſmooth, as are alſo the ſides of the Pillars which touch one another, being of a *whitiſh Free-ſtone* Colour, but a finer cloſer Grit; whereas when we broke ſome Pieces off them, the Inſide appeared like dark *Marble*.

The Pillars ſtand very cloſe to one another, and tho' ſome have 5 ſides, and others of them 6, yet the Contexture of them are ſo adapted, that there is no Vacuity between them; the Inequality of the Numbers of the ſides of the Pillars, being often in a very ſurprizing and a wonderful Manner, throughout the whole *Cauſway*, compenſated by the Inequality of the Breadths and Angles of thoſe Sides: ſo that the whole at a little Diſtance, looks very regular, and every ſingle Pillar does retain its own Thickneſs, and Angles and Sides, from Top to Bottom.

Thoſe Pillars which ſeem to be entire as they were originally, are at the Top flat and rough, without any Graving or *Striate* Lines; thoſe which lie low to the Sea, are waſhed ſmooth; and others that ſeem to have their natural Tops blown or waſhed off, are ſome concave, and others convex.

The high Bank hanging over the *Cauſway* on that ſide which lies next it, and towards the Sea, ſeems to be for the moſt part compoſed of the common ſort of Craggy Rock, only we ſaw a few irregular Pillars on the Eaſt-Side, and ſome farther on the North, which they call the *Looms*, or *Organs*, ſtanding on the ſide of a Hill; the Pillars in the middle being the longeſt, and thoſe on each ſide of them, ſtill ſhorter and ſhorter: But juſt over the *Cauſway*, we ſaw as it were the Tops of ſome Pillars appearing out of the ſides of the Hill, not ſtanding, nor lying flat, but ſloping.

We ſuppoſe each Pillar, throughout the *Cauſway*, to continue the ſame to the very bottom, becauſe all that we ſaw on the Sides were ſo.

Ib. p. 174. *NB*. The ſeveral ſides of one and the ſame Pillar are as in the Planes of *Chryſtals*, of very unequal breadths or lengths, call it either, when you meaſure them Horizontally; and that in ſuch as are *Hexagonal* a broader Side always ſubtends, or is oppoſite to, a narrower, which ſort of *Geometry* Nature likewiſe obſerves in the Formation of *Chryſtals*.

By Dr. Tho. Molyneux. *ib. p.* 175. 3. Among the ſeveral *Figur'd Stones* already deſcribed by Authors, I find none that has more Agreement with thoſe which compoſe our *Giant's Cauſway* than the *Entrochos*, the *Aſtroites* or *Lapis Stellaris*, and the *Lapis Baſanus* or *Baſaltes*: And yet for all the great Reſemblance they have in ſome Particulars, they differ very much in others.

The *Entrochos* agrees with the *Pillars* of our *Cauſway* in that it is a ſtony Subſtance, formed by Nature *Column-wiſe*, and conſiſting of 20 or 30 ſeveral *Internodia*, or *Joints*, ſet one a-top of another, but then it differs in that its outward Shape is round and *Cylindrical*; in its having a *Hole*, or *Pith*, run from top to bottom through all the Joints; in the ſetting on, or way of fitting one Joint to another; and in its Size and Magnitude.

The *Aſtroites* or *Lapis Stellaris* is not only ſhaped *Column wiſe*, as the *Entrochos*, and jointed with ſeveral *Internodia* cloſely adjuſted to one another; but its Sides are *Angular*. But then it muſt be obſerved that the Sides of the *Aſtroites* are always *ſulcated* or a little furrowed, and are conſtantly *Pentagons*;

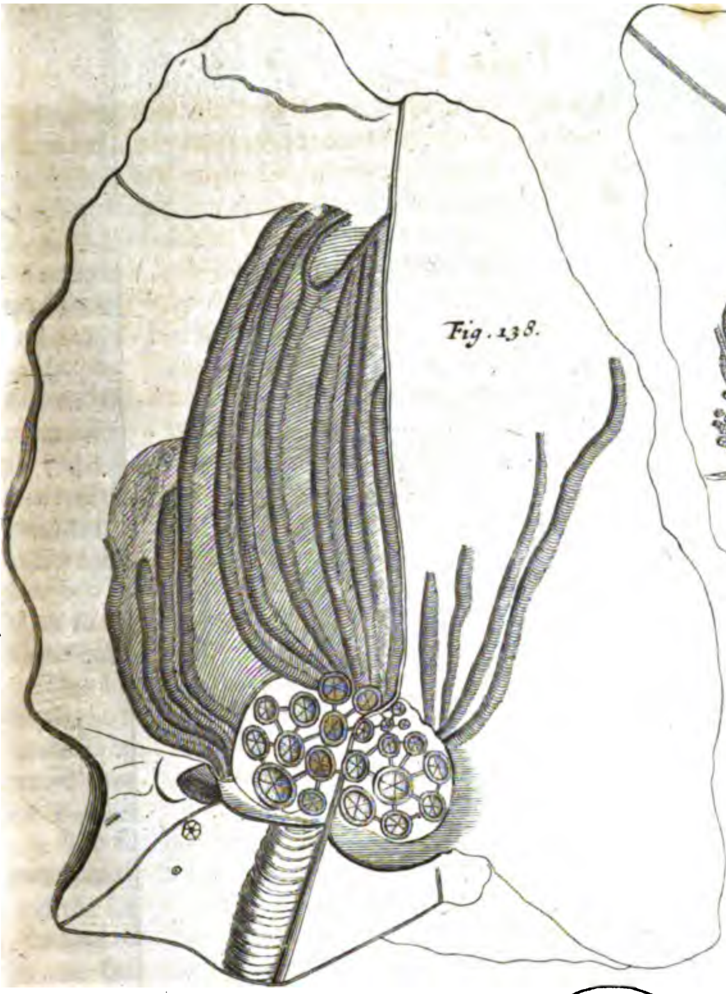


Fig. 138.

Fig

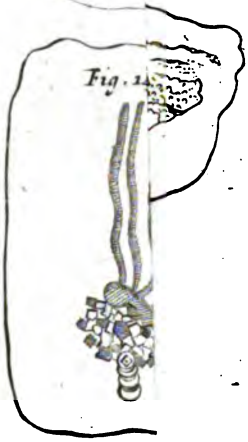


Fig. 1

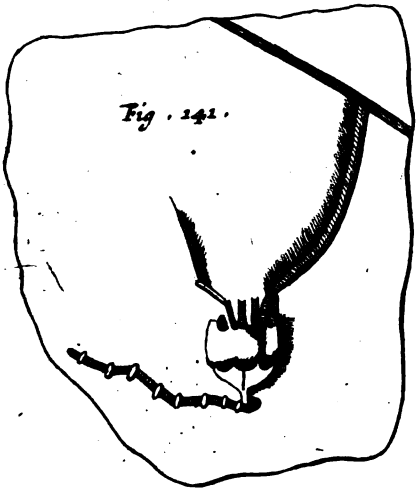


Fig. 141.

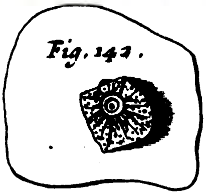


Fig. 142.

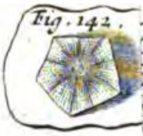
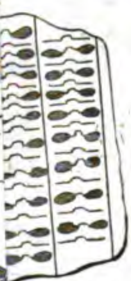


Fig. 142.



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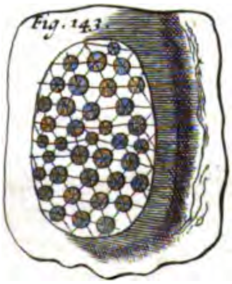


Fig. 143.

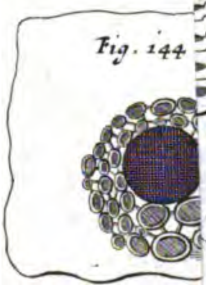
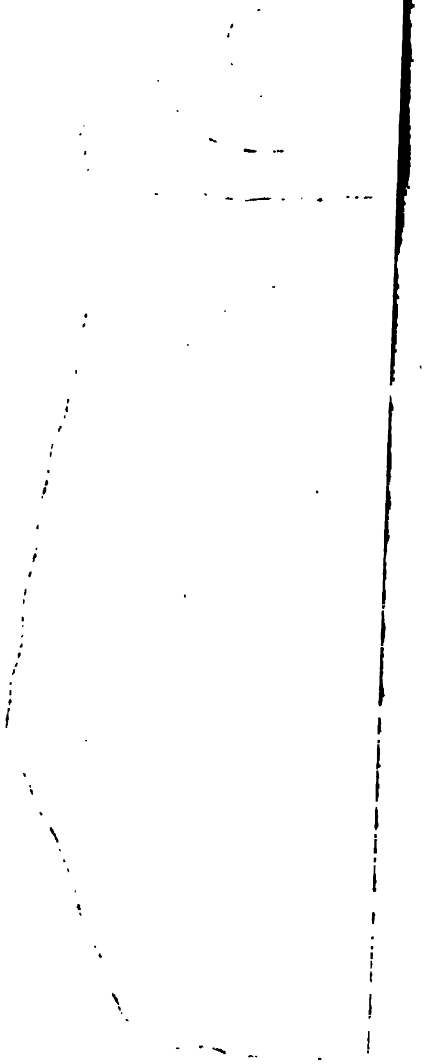


Fig. 144.



tagons; whereas the *Iriſh-Stone* has its Sides perfectly ſmooth, and *plane*, and ſometimes in *Hexagons* and *Heptagons* as well as *Pentagons*. Moreover, the *Aſtroites* has Furrow'd and Protuberant *Rays* ſtriking from its Center, ſomewhat as they draw a Star, whence it has its Name; that adapting the *Concavites* and *Convexites* together, cauſe the Coheſion of the Joints to one another: whereas the internal Superficies of the *Internodia* in our *Iriſh-Stone* ſends forth no ſort of *Rays* from its Center, and unite to one another by a quite different *Articulation*. For beſides what Dr. *Foley* remarks of the bottom or top of each Joint, having a large round *Concavity* or *Convexity* that extends it ſelf from the Center of the Stone within an Inch or two of the Angular Circumference; examining two Joints that were ſent up from the Place hither to *Dublin*, I obſerved likewiſe, that the bottom or top of each Joint round this *Concavity* or *Convexity* either riſes with an eminent *Verge*, or *Ridge*, if it be *Concave* in the Middle, or if it be *Convex*, is hollowed with ſuch a ſort of Groove, as to receive cloſely into it all the eminent Ridge of the next Joint either above or below it: ſo that each Superficies in the *Articulations* adapt themſelves on all ſides ſo exactly one to the other, as 'tis poſſible for two Bodies, that are only Contiguous and not Cohering.

The *Aſtroites* alſo, as well as the *Entrochos*, differs extremely from our Stone in its *Size*, or *Magnitude*; for the largeſt that is found of either of thoſe kinds, do not much exceed the thickneſs of a Man's Thumb, whereas our *Columns* are ſome of them two Foot in Diameter. Yet this diſproportion of Bulk is not ſo conſiderable a Difference, ſince we obſerve that Nature effects the like Diſparity in other of her Works, and thoſe too nearly allied, and evidently of the ſame Tribe, or Family. Our ſmall *Jointed Ruſhes* or *Reeds* and the largeſt *Eaſt-Indian Bambou*, one of which I remember to have ſeen in *Holland* above 26 Foot high, and as thick as a Man's Middle, are yet Plants of the ſame Species and Claſs.

But nothing among all the *Foſſil* Tribe that I have ſeen or read of, comes ſo nigh in all reſpects in its Formation, Subſtance, Size, Way of growth or Manner of ſtanding, &c. to the *Columns* whereof this *Cauſway* is compoſed, as the *Lapis Baſaltes Miſneus*, deſcribed by *Kentmannus* in *Geſner de Figuris Lapidum*, whereof he ſays there is a great large Bed within three Miles of *Dreſden* in *Saxony*. He gives the following Account of it thus; —— *A great many angular Stones glued as it were together, repreſent that kind of Marble called Baſaltes. They are of the Size and Shape of a middling Fig, very ſingular but Plenty enough of them, and ſo joined and fitted to one another, as if it was done by Art. They have ſeven, ſix, five, and ſome times though rarely, only four Angles. All together they have the Figure of a Beam ſtanding up, poliſhed on the Outſide, ſmooth to the Touch, of an Iron Colour, heavy and hard like Adamant. Theſe Stones thus cemented together ſtand up, ſome ſeven, ſome ten Ells above Ground. How far they ſink down into the Earth no Body yet knows.* But I find this Difference between theſe and the *Miſnean Baſaltes*, that its *Columns* were one entire Piece from top to bottom, whereas our *Iriſh Baſaltes*, is compoſed of *Columns* divided into many Joints. So that I think it may not improperly be called, to diſtinguiſh it from this and all other *Foſſils*, *The great* Iriſh Lapis Baſaltes *or* Baſanos, *having three Angles at leaſt, and at moſt eight, very neatly articulated at ſeveral Joints with one another, but eaſily ſeparable and knotty.*

Whether our *Iriſh Baſaltes* can pretend to the Name *Baſanos*, on the ſame account the *Miſnean* does, from the *Greek* Word Βασανίζω, *Exploro*, becauſe it has the Property of the *Touch-Stone*, that ſhews by Lines drawn with Metals on its ſmooth Surface, which are Genuine, and which Adulterate, I cannot poſitively ſay; becauſe thoſe Pieces I have, are ſo rough, that unleſs ſome part of the Superficies were artificially poliſhed, the Experiment cannot be made: Yet I have reaſon to believe it would ſucceed, were the Stone poliſhed; becauſe I find *Black Marble* in general, ſo it be of a cloſe Texture and hard, as this is, partakes of that Property.

A farther Account of the Giant's Cauſway; by Dr. Tho. Molineux, *n.* 235. *and n.* 241. *p.* 209.

4. To have a juſt Idea of this wonderful Production, I propoſed the laſt Summer 1697, to ſome Philoſophical Gentlemen here in *Dublin*, that we ſhould employ at our common Charge, one Mr. *Sandys*, a good Maſter in deſigning and drawing Proſpects, to go into the North of *Ireland*, and upon the Place take the genuine and accurate Figure of the whole Rock, with the natural Poſture of the Hills and Country about it for ſome diſtance. Accordingly we ſent him away with ſuch Inſtructions as I drew up for him, and he returned ſoon after with a fair and beautiful Draught very expreſſive of each Particular we deſired.

A. The *Great Cauſway*, which is from *B.* to *C.* 135 Yards, from *D.* to *E.* 120 Yards, and from *F.* to *G.* 64 Yards.

Fig. 151. *H.* The *Imperfect Cauſway*, which is 120 Yards long.

I. Stones the ſame as thoſe of the *Cauſway*, which lie on their Sides in the Hill.

K. Rocks in the Sea, which appear to be the ſame ſort of Stone.

L. The *Organs*, which are *Pillars*, the ſame with the *Cauſway*.

M. The *Chimneys*, which are Stone and make that Figure.

The *Pricked Line* in the *Cauſway*, ſhews how far the Sea flows at High-Water.

Fig. 152. *Fig.* 152. The Proſpect of the Eaſt-Side of the *Cauſway*.

There are alſo ſeveral of theſe kind of Stones ſeen in the Sides of the Rocks.

But the moſt inſtructive Part of the Scheme is that which expreſſes all the *various Figures* of the ſeveral *Joints* and *Columns* that have been found by careful Obſervation to make up the *Cauſway*.

Fig. 153. *N.* A Joint but of 3 Sides.
O. A Joint of 4 Sides.
P. A Joint of 5 Sides.
Q. A Joint of 6 Sides.
R. A Joint of 7 Sides.
S. A Joint of 8 Sides.

Fig. 154. *Fig.* 154. A Piece of a *Column* of 6 Sides tranſverſly divided in the Middle, the uppermoſt Part *a.* laid cloſe by the lower Part *b.* that the Manner may the better and more plainly appear, how the *Convexity* or *Riſing* of the Joint below, marked *c.* was let into the Hollow of the Joint above, marked *d.* when that was in its native Poſture, ſtanding a-top and covering it. By this ſort of *Articulation* the ſeveral Joints of the *Columns*, whether they conſiſt of 3, 4, 5, 6, 7, or 8 Sides, adapt and unite themſelves to one another; and obſerve in all the reſt of the Figures, *c.* denotes a *Convexity* or *Riſing*; *d.* a *Cavity* or *Hollowneſs*, in the Stone.

Fig. 155. Is a Collection of 7 *Columns* as they ſtand together in the *Cauſway*; and ſhew that though the *Pillars* differ from one another in their *Shape* and *Angles*, yet they adjuſt their Sides in ſuch a manner to the next immediate adjoining *Columns*, that there remains no *Vacuity* between them: For the *Pillars* are of ſuch various Figures, that all ſort of Inſterſtices, of what ſhape ſoever, are entirely filled up by one or other of them. *e e e e.* the Sides of the Pillars, which ſhew by their outward Surface that each *Column* conſiſts of many Joints placed one above another, from top to bottom; and theſe Joints ſo cloſely contiguous, that only a ſmall Creviſe or Line ſeems to ſever them; ſome with their *Convexities* uppermoſt, as thoſe marked *c.* others with their *Concavities*, as thoſe marked *d.* *Fig.* 155.

The *Triangular*, *Quadrangular*, and *Octangular Pillars* are much fewer in Number than thoſe other *figured Columns*: So that they do not come readily in ſight, except they be carefully ſearched after.

But this ſort of Stone is not more remakable for being cut thus naturally into *Regular Geometrical Figures*, than for being found in ſuch Plenty and vaſt Abundance in many Parts of this Country, for 4 or 5 Miles about. For beſides what goes under the Vulgar Name of the *Giant's Cauſway*, which itſelf alone is of a great Extent, and how far it may run into the Sea none can tell, there are many other Collections of the ſame kind of *Pillars*, ſituated in and about this Place; as two leſſer but more imperfect and broken *Cauſways* as we may call them, that both lie at ſome Diſtance on the Left Hand of the great one, as you face the North; and a little farther into the Sea ſome Rocks ſhew themſelves above Water, when the Tide is low, that ſeem all made ſtill of the ſame Stone. And if you aſcend towards the Land in the Hill above the *Cauſway* next and immediately adjoining to it, you meet with more of the ſame ſort of *Pillars*, but in a different Situation, not perpendicular and erect, but lying as it were on their Sides in a ſlanting Poſture.

Beyond this Hill Eaſtward, at ſeveral Diſtances, ſtand many Sets of ſtraight and upright Columns ranged in curious Order along the ſides of the Hills: that Parcel of them which is moſt conſpicuous and neareſt the *Cauſway*, the Country People call the *Looms* or *Organs*, from its formal Shape; which is ſo very regular, that all its ſeveral *Pillars* may be diſtinctly counted, and they are juſt 50 in Number; the largeſt and talleſt, at leaſt 40 Foot high, conſiſts of 44 diſtinct Joints, and ſtands directly in the middle of all the reſt, they gradually decreaſing in length on both ſides of it, like *Organ Pipes*.

Four Miles Weſtward of the *Giant's Cauſway*, a Mile and half diſtant from the Sea, three Miles from the Town of *Colrain*, and about two from

Dunluce, an old Seat of the Marquiſs of *Antrim*, ſeveral Ranges of tall Pillars ſhew themſelves along the ſide of a Rock, for about 300 Paces together; a Church within a quarter of a Mile of them called *Balliwillan* Church, I am told, was built for the moſt part with Stone taken from thoſe Pillars, which are all of the ſame ſort of Stone with the Columns of the *Giant's Cauſway*, (as I find by carefully examining and comparing together Pieces of them both I have now by me) and like thoſe too, conſiſt of regularly cut, looſe and diſtinct Joints placed one upon the top of the other; but in theſe reſpects they differ.

1. That ſome of theſe Inland Pillars are of a much larger Size than any in the *Cauſway*, being two Foot and a half in Diameter.

2. That there are only found among theſe, ſuch as have 3, 4, 5, and 6 Sides, and none that have 7, and 8, like ſome of the *Giant's Cauſway*.

3. That the Joints of theſe do not obſerve that kind of *Articulation*, by Cavities and Convexities, as thoſe of the *Cauſway* do; but their upper and lower Surfaces touch only in Planes, and they ſtand united by means of their Weight and Preſſure alone; ſo that a ſmall Force will ſever them.

But I find by obſerving the manner of the Commiſſure, or way of *Articulation*, in ſix Couple of the ſeveral Sorts of Joints of 3, 4, 5, 6, 7, and 8 Sides, which I had raiſed on Purpoſe, and taken out of the *Cauſway*, as they were naturally fellow'd in Pairs, that ſome of the Joints actually want this Cavity and Riſing, as thoſe of 4 and 6 Sides I have now in my Houſe, and are only united to one another by Superficies touching cloſe in Planes that run a little ſlanting and not parallel to the Horizon. Yet this may be only a chance Formation, ſince the univerſal Jointing of the whole *Cauſway*, is certainly otherwiſe. But I muſt take notice, that the Hollows and Convexities are not conſtantly formed and moulded in the Stone with all that accuracy and circular exactneſs, the Artiſt has pleaſed to expreſs them in the Figures.

Theſe Cavities in ſuch Joints as are uppermoſt, and lie expoſed to the open Air on the Surface of the *Cauſway*, afford no ſmall uſe and advantage to the poorer Sort of People in the neighbouring Country, with whom it is a common Practice in the Summer-Time, when they want Salt, to fill theſe natural Baſons with *Sea-Water*, which by reaſon of their Shallowneſs are of ſo commodious a Shape, that in the ſpace of four Tides they find all the Water that was left in them exhaled, and the Salt remaining dry in the bottom of the Hollows.

But there is another Irregularity I muſt take notice of, which is, that one of the Joints of the *Cauſway*, a *Pentagon*, ſent me hither to Town, is *Cavous* both at top and bottom: But the general Formation is this, that if a Joint be *Concave* at one end, the other end is *Convex*.

The vaſt towering Height of thoſe ſtrait-joined Pillars, eſpecially of thoſe that are moſt ſlender and the perfect among them, is truly very ſurprizing. There are in the *Cauſway*, ſome of 33, others of 36 Foot high above the Strand; and, as I ſaid before, ſome among the *Organs* equal 40 Foot in height. How far theſe may be continued under Ground, is not yet diſcovered: But a Gentleman of my Acquaintance traced one of the talleſt *Pillars* of the *Cauſway* by digging into the Strand, and it continued ſtill of the ſame Make and Figure, jointed as it was above, for the Depth of 8 Foot together, and he found no reaſon to doubt but he might have traced it much farther.

This is obſervable, that commonly the Joints, as well of the Inland Pillars, as thoſe of the *Cauſway*, as they have their Situation nigher the Earth, are longer and taller than thoſe towards the top of the Column; but no difference is obſerved in the Cavities or Riſings of the Joints, as they are placed higher or lower in the ſame Pillar: they continue much the ſame, as to their Depth or Protuberance from top to bottom; yet the utmoſt top of ſuch of the Pillars that ſeem compleat and entire, always terminates with the Joint that is flat on the upper Side, and no way either Concave or Convex like all the reſt below it.

As to the Internal Subſtance of this Stone, 'tis of an extraordinary hard, cloſe, and compact Texture: Its Greet or Grain, ſo very even and fine that it hardly appears, unleſs viewed near the Eye, and when the Stone is newly broke: Then it ſhews itſelf on its Surface like a very minute ſmall gliſtning Sand thickly interſperſed with the reſt of the Solid; which by reaſon its Parts are ſo firmly combined together, has ſomething more of gravity, in proportion to its Bulk, than moſt other ſorts of Stone, unleſs ſuch as partake of the *Marchaſite* or *Pyrites*, and are more ponderous than uſual from a *Metalline* Principle, being an Ingredient in their Compoſition; of which this does not at all participate, or at leaſt not in any conſiderable Quantity, that I can diſcover.

It ſeems as if it were one plain homogeneous Body, without any Mixture of *Cochlite*, *Belemnite*, *Veins* of *Spar*, or ſuch like extraneous Matter, ſo commonly met with in moſt other ſtony Concretes: Nor can there be obſerved *Rays*, *Furrows*, *Striæ*, or any manner of Lines running along its Superficies; ſo that it is capable of a good Poliſh, and I find has in Perfection that Quality of the *Lapis Lydius*, *Baſanus* or *Touchſtone*, ſo much celebrated of old, for ſhewing the various Impreſſions different Metals make upon it when rubb'd or drawn along the Surface; but being a Stone naturally divided into ſmall Pieces or Joints, and of ſo hard a Body, that it turns or breaks the Edges of the beſt Tools, when they offer to cut it, it ſeems unfit for the imbelliſhing of Houſes, and all the other greater Uſes of *Architecture* and *Statuary*.

Its rough and natural Outſide that is expoſed to the open Air, and beating of the Weather, is of a whitiſh Colour, much the ſame with what we ſee on common Rocks, and Lime-Stone; but the Inſide when you ſever one Piece from another, is of a blackiſh Iron-Gray, like that of the beſt black Marble before 'tis poliſh'd, but ſomewhat of a darker Shade. And indeed I can diſcover but little, if any, Difference between the Subſtance of this Stone and that of Marble. 'Tis true, the moſt common ſort of Marble is not near ſo hard and cloſe a Body: yet that does not import much, ſince 'tis known that ſeveral Kinds of Marble vary extremely from one another in Hardneſs.

Georgius Agricola, in his Book *de Natura Foſſilium*, has a Paſſage (and which I find confirmed too, by a later Author living in that Country, *Lachmand de Foſſilibus*, &c.) wherein he mentions a ſort of Marble found in the Diſtrict of *Hildeſheim* in *Germany*, that ſeems to bear in ſeveral reſpects a great Analogy or Agreement with this Stone of the *Giant's Cauſway*. " In *Hildeſheim* likewiſe over againſt the Caſtle of *Marburg* there is a Hill, " full of ſtony Beams, ſome of them ſtanding up a little above Ground; " they are long, placed in Heaps, and the Earth that is mixed with " them is of a black Colour. Upon ſtriking them with Iron or a Bit of " other Stone, they ſmell like burnt Horn the ſame as the Marble at *Hilde-* " *ſheim*, and are quite of the ſame Subſtance with it." He does not indeed tell us the preciſe Figure of theſe Marble Beams, yet it ſeems probable at leaſt that ſome were ſquare, which makes him call them, *Trabes Lapideæ.* But however that might be, this I am aſſured of from frequent Experiments, that the Marble of the *Giant's Cauſway* like theſe *ſtony Beams*, when forcibly ſtruck with another Stone or a Bar of Iron, ſends forth a ſtrong offenſive Scent like burnt Horn.

The Growth of Spar, and Formation of Rock-Plants; by Mr. J. Beaumont, *n.* 129. p. 744. *Vid. Sup.* §. LIX.

LXXVII. The beſt way to explicate the *Vegetation* of *Rock-Plants*, is, firſt to repreſent the ſeveral Ways of the Growth of *Spar*, which (to paſs by the Account from *Helvetia*, that Snow by long lying and continual Froſts is hardened into *Spar)* I obſerve to be three; either, 1. it takes a Being from Steams alone; or, 2. from Steams coagulating either Dew as it falls on the Ground, or Waters iſſuing from the Joints of the Rocks under Ground; or, 3. it grows from Earths and Clays. We have an Inſtance of the firſt in many *Grotto's*, where ſome *Spars*, produced from Steams alone, hang from the Roofs like *Icicles*; *Lead-Ore* often growing in the ſame manner: And as this *Spar* grows downwards, ſo, in many Places from the Sides of it, there iſſue little Plants of *Spar* which ſhoot upwards, contrary to the Growth of the other. Thus *Spars* grow from Steams about the *Baths* at *Buda* in *Hungary*, according to the Relation of Dr. *Brown*. An Example of the 2d is given above; where 'tis ſaid, that at a certain Place in *Italy*, Chryſtals (which are a ſort of *Spars)* are produced in clear Evenings, by a Coagulation of Dew falling on *nitrous Steams*. We have ſome of the like Riſe on *Mendip-Hills*; our Miners finding ſometimes in Roads, where the Earth is bare, *triangular* Chryſtals, about 2 Inches in length, and an Inch over; not with ſharp Angles, like the *triangular* Glaſs, but with round and blunt Angles, and carried up round at the Ends like a *Cocoa-Nut*; none of theſe being ever found in digging. I have alſo ſeen of the ſame Sort, which were taken up in *Glouceſterſhire*. So again it is commonly ſeen in *Grotto's*, that *Steams*, *coagulating Waters*, iſſuing from the Joints of the Clefts, produce *Spars* of all Colours. As to the 3d Way of Generation, to wit, from Earths and Clays, becauſe I do not remember to have met, in any Author, with a ſatisfactory Account thereof, I ſhall briefly relate to you what I have obſerved herein.

Vid. Sup. Cap. II. §. XXXIX.

Vid. Sup. §. LX.

There

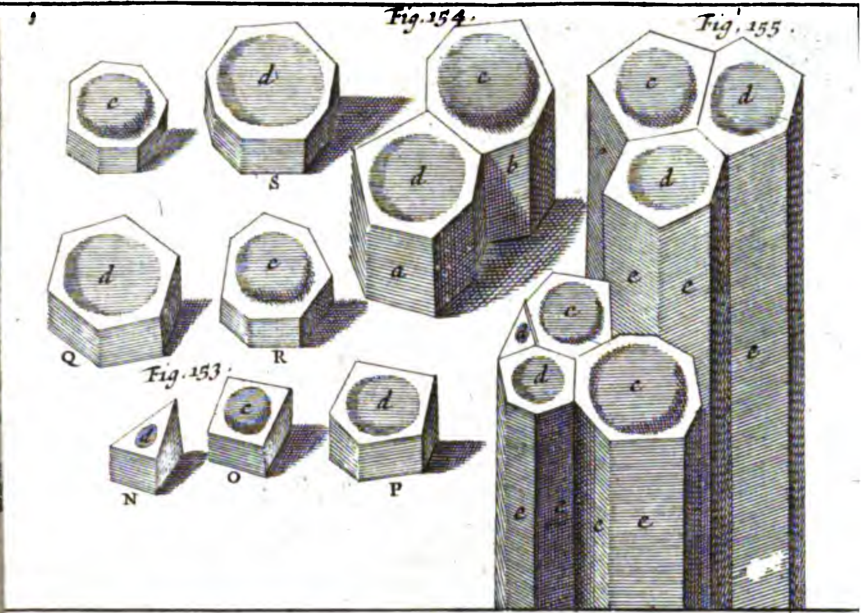
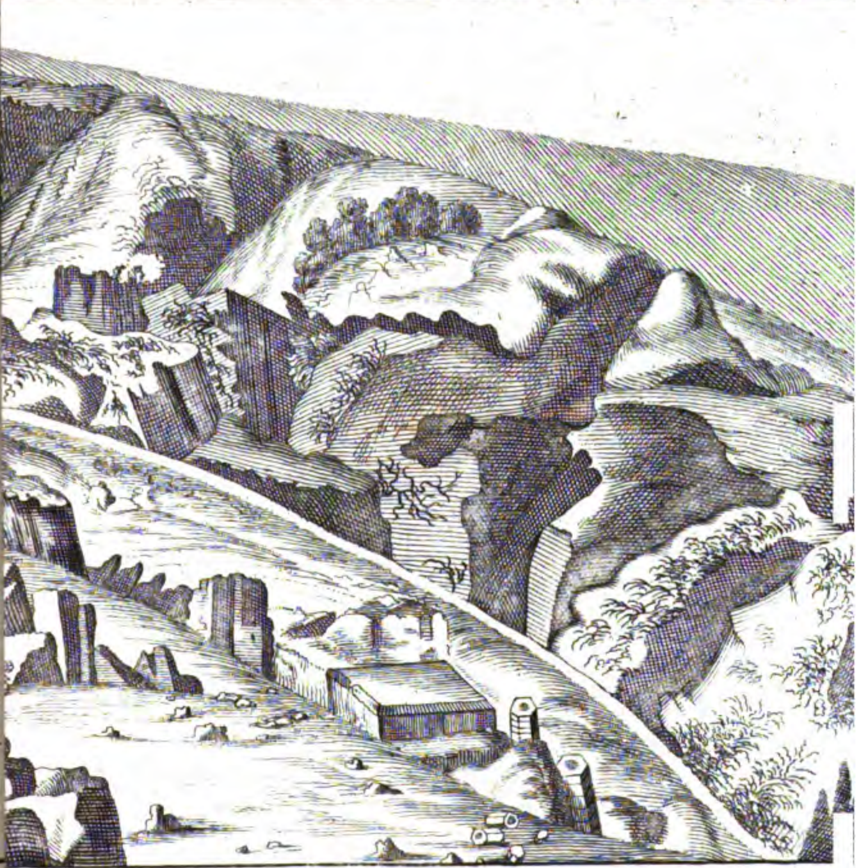


Fig. 154.
Fig. 155.
Fig. 153.



There are in *Mendip-Hills*, and generally where Mines are, *ſubterraneous Vaults* or *Grotto's*, whereof ſome which are pretty deep, and admit not Air too freely, and have other Conditions required, are ſaid, by our Miners, to be Quick, having often *Ore* in them, and ſtill lively-colour'd Earths, with ſome Moiſture and lively *Spars*: Others admitting Air 2 or 3 ways, and having in them black and moiſt Rocks, and dry and rotten ſhelly Stones, dark Earths, barren Sands and the like, being ſaid to be dead. I have often ſearched both; and in ſome of the former, particularly in one of them, which is 35 Fathoms deep, by a perpendicular Line (though the oblique Deſcent of it, makes it above 50 Fathoms to thoſe that go into it) I diſcovered this Proceſs of Nature in the *Formation* of *Spar*. There are in the Bottom of this *Grotto* ſome Beds of Clay, and others of a liver-coloured Earth, which I take to be as good a Bole as any now in uſe: it is inſipid to the Taſte, but ſmells well, eſpecially when dried; for, as it lies, it is moiſt and like Paſte, made ſo partly by the diſtilling Waters, and partly by a Steam incumbent on the Place raiſed from thoſe *Waters* by the *Mineral Ferments*. This Earth and Clay there ſhoots up every where in *Spires* in all Proportions in Height, from the firſt Buddings out of it, till it comes almoſt as high as a Man's Finger; the biggeſt of them being in Thickneſs about an Inch Diameter. Theſe Spires are all ruled up with irregular Ridges and Furrows, and ſome ſooner, ſome later, begin on the top to be congealed into *Spar*; and ſo gathering a Cruſt downward by degrees, are all at laſt turned into an abſolute *white Spar*, with ſome *Diaphaneity*. I diſcovered the ſame Earth in ſome Places there growing *Spherical*, which, whilſt it is Earth, is ſtill ſticking in its Bed; but afterwards, as it comes to be cruſted over, and at laſt to be turned into *Spar* like the other, it grows clear off from its Root, as Fruit falls from the Tree when ripe. I have by me of theſe *ſpherical Stones*, from the bigneſs of an ordinary Bullet, to that of a great Pin's-Head, ſome turning to *Spar* ſooner than others: I found ſome quite grown off, ſome half grown, ſome *white Spar* outwardly, and raw Earth in the middle, ſo that the Proceſs was as plain to me as I could wiſh. I ſaw the ſame Earth in ſome Places there growing in an exact *Oval* Form, and turning into *Spar* not *Oval*, but raiſed on both Sides with an Edge round it like *Apricock-ſtones*: And as theſe *Spherical* and *Oval Stones* are moſt exact in their Figure; ſo, notwithſtanding the Rector fails in this Vault, to give a true *Sexangular Figure* to thoſe which I ſaid ſhoot up *Pyramidally*; yet there is a certain Place on theſe *Hills*, where the *Spars* grow all *ſexangular*, both Points of them terminating into a *Pyramidal* Figure, *ſexangular* likewiſe, as the Veins of Chryſtal found in *Italy* produced by a Coagulation of Dew, theſe with us probably having the ſame riſe, lying alſo on the Surface of the Earth. Here I may acquaint you, that I find Talk on theſe Hills growing *ſexangular*; the ruſt which oftentimes lies over Veins of *Lead-Ore* in many places, ſhoots up *Pyramidally*, and is bounded round with 6 Angles, and ſometimes with 5: *Lead-Ore* itſelf often ſhoots up *Pyramidally*, with rough irregular Lines round it, and in ſome places I find it bounded round very regularly with 4 Angles; in other places it grows branched like a Plant, as I have ſeen in a Mine where the *Stone-Plants* grow.

Vid. Sup. §. II.

As to that Opinion which generally ſolves thoſe various *Phænomena* of the ſeveral figured Stones, which we find in Mines and elſewhere, by ſaying, That they are Part of *Plants* and *Animals*, or whole ones petrefied; it ſeems not to be grounded on Practical Knowledge. Thus when we find ſeveral ſorts of *Shell-Fiſh* in Mines, as there are ſome in the Clay where thoſe Stone-Plants grow, we muſt not fly to Petrefaction, as though they had been brought there by the Sea, or otherwiſe, and ſo petrefied; but we muſt take that to be (as it is truly) the natural Place of their Birth; ſome of them being raw Clay, others with the ſame Texture with the Rock where they grow, and others of as abſolute a ſhelly Subſtance as any in the Sea: theſe being only different Gradations of Nature, which can as well produce Shells in Mines as in the Sea, there being no want of ſaline or earthly Particles. Nor is there any great difference betwixt ſome ſorts of *Spars*, and *Sea-ſhells*; neither do I know, why *Shells* might might not as well be produced in Mines, as any ſort of *Spars* are in the Sea: for inſtance, the *Fungi Marini*, which are of a ſparry ſubſtance, ſome of them having their Surface all wrought with Flowers, as it were, which are only the *Terminations* of *ſparry Cells*, as in *Coral*; and *Coral* itſelf is a ſort of *Spar*, which ſo well reſembles our Stone-Plants in its growth, eſpecially if ſome of it be jointed, as Mr. *Ray* informs us, that I know not a more apt Name for theſe than to call them *Mineral Coral*; unleſs ſome haply will rather ſay, they are *Fluores Arboreſcentes internodiis diſtincti*; and as I find the Bodies and Branches of ſome *Coral* are all ruled up with Lines, ſo are many of theſe in ſome Mines, and are terminated with Cells like it.

Vid. Sup. §. XXV. Mr. *Liſter* judges that *Shells* found in Stone-Quarries were never any Part of an Animal, and gives this probable Reaſon for it, becauſe Quarries of different Stone yield us quite different Species of *Shells*, not only one from another, but from any thing in Nature beſides, which either the Land, ſalt or freſh Water, does yield. I have obſerved the ſame thing ſome Years ſince, and have now by me ſeveral Species of Stone reſembling *Shell-Fiſh*, which I gathered from ploughed Fields and Quarries, that are ſcarce to be parallel'd, as I judge by all the Collections of Sea-Shells extant.

To examine this Opinion of *Petrefaction* further; I only find, that the Thing ſuppoſed to be *Petrefied* becomes firſt cruſted over with a ſtony Concretion, and afterwards, as it rots away inwardly, the *Lapideſcent* Juice inſinuates itſelf by degrees into its room, and makes at laſt a firm *Stone*, reſembling the thing in Shape; which may lead ſome to believe it really *Petrefied*. But, though a real *Petrefaction* were allowed in ſome Caſes, it would not be rational to plead this in all the figured Stones we ſee, in regard of thoſe many Grounds we have for the contrary. But I take theſe to be the chief Reaſons which make ſome ſo ready to embrace ſo generally this Conceit of *Petrefaction*, becauſe they are prepoſſeſſed with an Opinion againſt the *Vegetation* of all Stones, and for that they think it impoſſible for Nature to expreſs the Shapes of Plants and Animals where the *Vegetative Life* is wanting, this being a Faculty peculiarly belonging to the *Soul*: whereas they ſeem to err in both; for as what hath been ſaid concerning

our

your *Stone-Plants*, may ſuffice to prove their *Vegetation*, ſo it will be as eaſy to ſhew, that Nature can and does work the Shapes of *Plants* and *Animals* without the help of a *Vegetative Soul*, at leaſt, as it is ſhut up in common *Seeds* and *Organs*. To be ſatisfied of this, let them view the *Figurations* in Snow; let them view thoſe delicate Landſkips which are frequently (at leaſt in this Country) found depicted on Stones, carrying the reſemblance of whole Groves of Trees, Mountains, and Valleys, *&c.* let them deſcend into Coal-Mines, where generally with us the Clifts near the Coal are all wrought with curious Repreſentations of ſeveral ſorts of Herbs, ſome exactly reſembling *Fern-Branches*, and therefore by our Miners called the *Fern-Branch Clift*; ſome reſembling the Leaves of *Sorrel*, and ſeveral ſtrange Herbs, which haply the known *Vegetable Kingdom* cannot parallel; and though it could, here can be no Colour for a *Petrefaction*, it being only a *ſuperficial Delineation*. The like may be ſaid of *Animals*, which are often found *depicted* on *Stones*; as all *Mineral* Hiſtories will ſufficiently inform them. Now ſince here is no Place for *Petrefaction*, or a *Vegetative Soul*, we can only ſay, That here is that *Seminal Root* (though hindered by the unaptneſs of the Place to proceed to give theſe things a *Principle* of *Life* in themſelves) which in the firſt *Generation* of Things made all Plants, and, I may ſay, *Animals* riſe up in their diſtinct Species; God commanding the Earth and Waters to produce both, as ſome Plants and Animals riſe up ſtill in certain Places, without any common Seed.

It is a Thing of very difficult Search, to find what this *Seminal Root* is, which is the efficient Cauſe of theſe Figures: But it ſeems to me not very unapt to explicate it according to the ſaying of *Heraclitus*; *Lux Sicca*, *Anima Sapientiſſima*, that is, where there is a ſtrong Internal Light to expand the Ideas, and a Drought to terminate them, the Vertue of a Soul is ſtill preſent, which imprints them in the Matter. Hence we find Nature is moſt buſy in the Kind where her Intentions are highly raiſed by the Preſence of her chief *Principles*, Salts, Sulphurs, and Mercuries, promoting her Ferments, which cauſe ſome Internal Light and Drought, the *Ignes Fatui* being only ſhadowy Reſults from them: Thus we ſee over and in Beds of Clays and Marles, which have ſtrong Ferments, being well impregnated with Salts, there often lie Beds of *Marchaſites* full of *Luminous* Particles, and there we frequently find great Numbers of *Lapides Serpentarii*, and *Marchaſites*, reſembling Snakes; and ſo ſeveral other figured Stones, as the *Belemnites*, &c. And in the Joints of the *Lias Stones*, growing over Beds of Clay, we often meet with a great Plenty of elegant Landſkips. In Coal-Mines, where the Sulphurs are ſtrong, we find great Lumps of very bright *Marchaſites*, and great Varieties of Herbs depicted as is ſaid before. In Mines of Metals, where the *Mercuries* are generally predominant, there are Landſkips and Repreſentations both of Land and Sea Animals, whereof ſome carry a bulk, others are only ſuperficially delineated. Thoſe who endeavour to explicate thoſe Figurations mechanically, ſeem to have a harder Taſk; for if they ſay with *Hippocrates*, *Spiritu Diſtenta omnia pro Generis Affinitate diſtant*; as though when the Mineral Spirits had extended the Matter, it *Lib. de Nat. Puer.*

fell into theſe Figures upon a ſpontaneous Receſs, according to its proper Weight, which gives Order and Meaſure to Things; as he mechanically ſhews by a Bladder, into which, if Earth, Sand, and Filings of Lead be put, and Water be added to them, and we give them Motion by blowing in the Bladder through a Reed, firſt they are mixt together with the Water, but in a while continuing in a gentle Motion, they ſeparate themſelves, and retire each to its like, the Lead to its Lead, *&c.* I ſay if it be explicated thus, it ſeems difficult to conceive how the Matter ſhould come to have ſuch a determinate Weight to run into ſuch Figures, without a *Specifical Rector* to intend and diſpoſe it, unleſs a general one be admitted, in whoſe Vertue all known and poſſible Species are, which firſt introducing Diſpoſitions in the Matter, he intentionally works; and, as ſometimes he gives that Weight to the Matter, not endowing it with a *Principle* of *Life*, ſo he often diſpoſes it to receive Life, and introduces it; which Poſition I conceive will hold good, notwithſtanding ſome late induſtrious Eſſays to prove that there is no equivocal Birth.

A Rock of Natural Salt in Cheſhire; *by Mr.* Adam Martindale, *n.*66.*p.*2015.

LXXVIII. Here is lately found in *Cheſhire* a *Rock* of *Natural Salt*, from which iſſues a vigorous ſharp Brine, beyond any of the Springs made uſe of in our *Salt-Works*. There runs near it (at leaſt in the Winter-Seaſon) a ſmall Rindle (or Gutter rather;) but it is wholly free from all danger of Overflowing, which threatens all other *Salt-Pits* in this Country every great Shower through the Vicinity of Rivers. The Rock of *Salt*, by the relation of the Workmen, is between 33 and 34 Yards diſtant from the Surface of the Earth. That Parcel of it which the Augur brought up was as hard as *Alum*, and as pure, and when pulverized became an excellent, fine, and ſharp *Salt*. The firſt Diſcoverer of it was one *John Jackſon* of *Halton*, about *Lady-Day* laſt, (1670) as he was ſearching for Coals on the behalf of the Lord of the Soil, *William Marbury* of *Marbury* Eſquire.

The Salt-Mines in Tranſylvania *and* Hungary; *by* Dr. Brown, *n.*58.*p.*1101.

LXXIX. There are two kinds of *Tranſylvanian Stone-Salt*: The *Sal Gemmæ*, and that which is commonly uſed at Table. The latter is found in moſt of the *Salt-Mines*; and is brought in great quantities down the River *Tibiſcus*, and the Rivers running into it: Some of which is afterwards ſent down the *Danube*, and up the *Morava* to furniſh *Servia*, and the adjacent Provinces; and a great Part of it up the *Danube* into *Hungary*. But they bring it no higher; Stone-Salt being prohibited by the Emperor in *Auſtria*, who hath a conſiderable Profit upon the boiled Salt brought from *Hallſtadt* in that Province.

I have alſo received an Account, that half an Hour's going from the City *Eperies*, there is a Salt-Mine of great Note; from the firſt Place of deſcent unto the bottom, it is about 180 Fathoms deep: Into this the Miners deſcend firſt by Ropes, and at laſt by Ladders, unto the lower Parts. The Mine is for the moſt part in an Earthy, and not a Rocky Ground.

The Veins of Salt are large, and there are Pieces to be found of 10000 Pound Weight. They commonly hew out the Salt into long ſquare Pieces of 2 Foot in Length, and one in Thickneſs; and for uſe, it is broken and grinded between two Grind-Stones.

The Mine is cold and damp, but the *Salt* being a Stone-Salt, is not eaſily diſſolved, or at leaſt in any great quantity, by dampneſs or moiſture: Yet the Water of the Mine is impregnated with *Salt* in ſuch ſort, that being drawn out in large Buckets, and afterwards boiled up, it affords a blackiſh *Salt*, which they give to their Cattle in the Country.

The Colour of the ordinary *Stone-Salt* of this Mine is not very white, but ſomewhat grey; yet being broken and grinded to Powder, it becomes as white as if it were refin'd. This *Salt* conſiſts of pointed Parts or *Faſſets*: Another ſort of Salt there is, which conſiſts of Squares and Tables; and a third, to be found of ſomewhat *ſtirious* or *long Shoots*.

Nor is all the Salt of this Mine of one Colour, but of divers; that which is found groſly mixt with the Earth, receives ſome Colour from it: And even that, which is moſt pure, and reſembleth *Chryſtal*, doth often receive Tinctures of ſeveral Colours. In the middle of a Chryſtal-Salt with long Shoots, I have ſeen a delicate Blue; and Count *Rothal* hath a large Piece, of a fair Yellow. There are alſo ſome Pieces very clear and tranſparent, ſo hard that they carve them into divers Figures, as Croſſes, Crucifixes, and others.

I cannot omit to advertiſe you, that whereas theſe Salts, tho' kept without Care, remained dry for many months in other Countries, yet they began ſomewhat to relent ſoon after I came into *England*; and if they be kept in a Stove or very hot Place, they will be apt to loſe their Tranſparency.

LXXX. The Mines of *Sal Gemmæ* in *Poland*, a Mile diſtant from *Cracovia*, near the ſmall Town of *Wilizka*, which (the Church excepted) is altogether digged hollow under Ground, hath 4 Deſcents: Of which the two chief being in the Town itſelf, are thoſe through which the Salt is drawn up; the other two do ſerve for letting down Timber and other Neceſſaries. Theſe Deſcents, or Holes, are ſquare; 4 or 5 Foot long, and as broad, lin'd downwards through with Timber. Above, is a great Wheel, with a ſtrong Rope, of the Thickneſs of a luſty Arm, drawn about by a Horſe, like as in a Horſe-Mill.

Sal Gemmæ Mines in Poland; By . . n.61.p.1099.

He that will deſcend, muſt cover himſelf with a Frock, and have another Man that faſtens another Rope, to the aforeſaid big Rope, and having ſo tied it about himſelf as to ſit in it, takes one in his Lap and holds him faſt about; whereupon the big Rope being let ſomewhat down, another faſtens likewiſe a Piece of Rope to the other thick Rope and does like the former, ſeating himſelf in it, and taking and claſping another Man in his Lap, and being alſo let down a little way, gives place to others to do the like; in which manner, 30, 40, and more Perſons may be let down all at once; of whom the firſt having touched the Ground, ſteps out and goes aſide, the reſt following him and doing the like. And thus they deſcend to the Depth of 100 Fathoms. But then they take a Lamp and lead People about by ſtrange Paſſages and Meanders, ſtill more and more deſcending, till they come to certain Ladders by which they go down 100 Fathoms deeper, where there are double Paſſages and Holes one above another, in abundance; for the Mine-Men dig on ſtill, and cut out every where and on all Sides, as long as the Salt-Vein laſteth. The great Holes, to ſecure both the Town above, and the Work below from falling in, are very carefully filled out, and ſupported by ſtrong and well-compacted Timber.

Out of theſe Mines they dig and cut out 3 ſorts of Salt; one is common, coarſe and black; the ſecond ſomewhat finer and whiter; the third very white, and clear like Chryſtal. The coarſe and black Salt is cut out in great Pieces, roundiſh and 3 *Polonian Ells* long, and one Ell thick, which coſts from 50 to 70 *Polonian Florins*.

Mean time the Inhabitants of *Cracow* have a Privilege, whereby a certain Number of Pieces is to be delivered to them, at 8 ſuch Florins the Piece. The greateſt Pieces lie before their Doors, where the Cattle paſſing to and fro, lick off thoſe Salt-Stones, which afterwards, by Mills and other Engines, are ground and beaten ſmall for Uſe. The Colour of theſe Salt-Stones is darkiſh Grey, with ſome Mixture of Yellow.

When this Salt-Work was firſt found, (which is now above 400 Years ago) the *Mine-Men* which firſt began to work in it were *Germans*; whence the *Poles* have retained the *German* Names of the *Tools*, but given them *Poliſh* Terminations. Theſe *Salt-Works* belong to the King of *Poland*, who appoints and maintains the Officers of them; and 'tis one of his beſt Royal Revenues, amounting to a conſiderable Sum of Money. There is no leſs than 1000 Men, that are conſtantly employed in theſe Mines; and there was then a Proviſion of *Salt* valued at two Millions.

There are in theſe Works three Horſes that ſtay always below, having their Stable and other Neceſſaries there: They carry the Salt from the Places where it is cut and digged out, to thoſe whence it is, by the abovementioned Wheel and Ropes, drawn up by a Horſe above Ground going round about. The Horſes, after they have been a while under Ground, grow blind from the Sharpneſs of the *Salt*; and one of them that had been longeſt in thoſe Mines, had the Hoofs of his Feet grown as long again as they are uſually; ſo that each Hoof was near a Span long. This *Salt Work* hath alſo beneath it certain *Salt-Springs*, whence the *Salt Water* is by Channels conveyed to ſeveral Places, where it is boiled to Salt.

But there is yet another *Mineral Salt-Work* in *Poland*, *viz.* at *Bochna*; but not ſo well ordered as the former. Beſides, there are ſeveral other Places in *Poland*, and in *Ruſſia* alſo, which yield Salt; as at *Holuz*, *Colomeja*, *Solum*, *Pintz*, *Oſwentz*, &c. In the *Podelian* Deſart, near the River *Boriſthenes*, is a Salt-Lake, whoſe Water is by the Heat of the Sun waſted, and turned to Salt, like unto Ice, ſo that the People there ride into it with Horſes and Waggons, and cut it into Pieces and carry it away; as the *Poliſh* Hiſtorian *Cromerus* at large relateth: who alſo affirms, That in the aforeſaid *Salt-Work* at *Bochna* they find a frozen Subſtance, which by them is called *Carbuncle*, uſed by the People to purge their Bodies, by Grating and Drinking it in a convenient Vehicle.

LXXXI.

The Natron *of* Egypt *and* Nitrian Water *examined; by Dr.* Ch. Leigh, n. 160. p. 609.

LXXXI. 1. The *Natron* of *Egypt* is an *Alkali Salt* perforated like a Sponge, and of a *Lixivial* Taſte; and thus I find it deſcribed by *Pliny*, *Mathiolus*, and *Agricola*.

Its Principles I take to be chiefly two; *viz.* a *Sal-Marine* and an *Urinous Salt*.

That it contains a *Salt-Marine*, ſeems manifeſt by theſe Experiments; *1ſt*, becauſe a *Solution* of the *Natron* has the ſame *Taſte* that a *Solution* of *Salt-Marine* hath; *2dly*, In Evaporation the Particles of the *Natron* incruſtated upon the Surface of the Water, as the Particles of *Sea Salt* do in Evaporation. *3dly*, Becauſe the *Natron* is *Perforated*, which proceeds (as I ſuppoſe) from a *Sal-Marine*, for that, when it *Chryſtallizeth*, ſhoots with little Cavities. *4thly*, If the *Natron* be mixt with *Salt* of *Tartar*, it emits the ſame Spirit as *Sal-Armoniack* when mixt with the ſame Salt. And *Laſtly*, That it contains a *Sea-Salt* ſeems plain from *Ceſalpinus*, ſays he, *Effloreſcit etiam ſponte non ſolum in* Salinis *ad ſimilitudinem* Lanugenis *Caneſcentis*; *ſed etiam in Vaſis in quibus* Sal *continetur*.

But here it is to be noted, that though the *Nitrian Water*, is of a bluſhy Colour, and makes a briſk *Fermentation* with an *Acid*; yet a Solution of *Natron* looks clear, and will not *ferment* with an *Acid*. The Reaſon why a Solution of the *Natron* looks clear, though the *Nitrian Water*, which is but a Solution of the ſame Salt, is of a bluſhy Colour, may perhaps be this; I ſuppoſe that the *Water* of *Latron* receives it Redneſs from a red clammy Subſtance, which ſerves chiefly to cement the two Salts together. And this I rather conjecture, becauſe, after a Solution of the *Natron* had paſt through a *Filtre*, there ſtuck to it a red clammy Matter, and the Solution was clear. And the Reaſon why a Solution of the *Natron* will not *ferment* with an *Acid*, I conceive to be this; becauſe that in a perfect Diſſolution, its Parts being ſeparated one from another, by the Parts of the Water, their Strugglings are too weak to make an *Efferveſcency* with an *Acid*; and in this I was further confirmed by theſe two Experiments. I found that if into a *Solution* of the *Natron*, I poured an *Acid*, while the Water looked whitiſh or diſturbed, the Salt not being perfectly diſſolved, it made a briſk *Fermentation:* But when the Water came to be clear, the Salt then being perfectly diſſolved, if I then poured an *Acid* upon it, it would not *ferment*. I likewiſe found that this *Solution*, being evaporated to a third part, would *ferment* again.

Its ſecond Principle I take to be a *urinous Salt*: *1ſt*, becauſe, if mixed with *Salt* of *Tartar*, it ſmells like *Sal-Armoniack*, when mixed with the ſame Salt. *2dly*, When it was diſtilled with *Salt* of *Tartar* in a *Retort*, it afforded a *urinous Spirit*, as piercing as the *Spirit* of *Sal-Armoniack*.

The *Sal-Marine* (being a *Foſſile Salt*) I take for granted it receives from the Earth, but it ſeems to have its *Volatile Alkali* from the Air: *Firſt*, becauſe it is ſaid by *Pliny*, *Spumam* Nitri (which is the *Natron* here ſpoke of) *Antiqui negabant fieri niſi cum* Ros *cecidiſſet*. By M. *de la Chambre*, it is affirmed, That three or four Days before the *Nile* begins to overflow, there falls a certain Dew, which hath a fermenting Virtue, and levens a Paſte expoſed to the Air; and, at the ſame time, ſaith *Pliny*, and M. *de la Chambre*, the *Nitre-Pits* grow full of *Nitre*. And *Sands*, *Vanſlebius*, and ſeveral ſay, That though 500 in a Day die in *Grand Cairo* of the Plague, before the beginning of the Inundation of the *Nile*, yet the very Day after there does not one die; which, doubtleſs, could not proceed from any other Reaſon, than becauſe, at that time, the Air was impregnated with this *Volatile Alkali:* for, at that time, the *Nitre-Pits* grow full, and this Dew falls. This, I think, may ſufficiently hint to us the great Uſe of this *Volatile Spirit*, eſpecially in peſtilential Diſtempers. *Laſtly*, About that time that the *Nile* begins to overflow, thoſe Specimens, which we have here at *Oxford*, grew heavier by being expoſed to the Air.

Here it is to be noted, that this *Alkali* is not made ſo by Fire: I cannot therefore conclude with *Helmont*, that all *Alkalies* are made ſuch by that Element.

The learned Dr. *Huntington*, (who was at *Nitria*) gives this Account of its Separation from the Water in *Latron*.

There is a Town in *Ægypt* call'd *Nitria*, which gives Name to the *Nitrian Deſert*, where there is a Lake call'd *Latron*, taking up an Area of 6 or 7 Acres, ſituated about 30 Miles W. by S. from *Terena*, a Town lower upon the *Nile* than *Grand Cairo*, and about the ſame Diſtance N. W. from the *Pyramids*; from the Bottom of this Lake, this ſort of *Nitre* called *Natron* ariſeth to the Top, (as they do apprehend) and there, by the Heat of the Sun, condenſes into this kind of Subſtance. That all the *Nitre* comes from the Bottom to the Top, I dare not affirm, and ſhall therefore premiſe ſome *Phænomena* which it afforded in Evaporation, before I give you my Conjecture about it.

I took an *Evaporating Glaſs*, which held about 4 Ounces, and poured into it 2 Ounces of the *Nitrian Water*; this I ſet upon a Sand Furnace, giving it Fire by degrees: as ſoon as the Water was warm, the Particles of the *Nitre* began to ſwim upon its Surface in ſtraggling and uneven Numbers; theſe, after a while, united; and at laſt there aroſe Salt ſufficient to cover the whole Superficies of the Water. I took then a thin Glaſs and ſkimed off this Ice, but could ſcarce take it all off before it was ſeconded by another; and thus the Salt did riſe ſucceſſively in Films, as long as there was any Water in the Glaſs: Theſe Films had the Colour and Taſte of the *Nitre* which came from *Nitria*, and did like it *ferment* with an *Acid*. And theſe are they which, by *Pliny*, are called *Flos Salis*; and, if I miſtake not, the ſame with that which *Herodotus* ſays they make their *Mummy* with. If therefore by the languiſhing Heat of a digeſting Furnace, the *nitrous* Particles could ſeparate themſelves from the Water, and over that ſpread themſelves in an Ice; it may be as probable, that by the greater Heat of the Sun, the *Nitre* of *Latron* is ſeparated from the Water after the ſame manner. And as in the Evaporation of all other Mineral Waters, when the Water is not ſtrong enough to hold up the Salt, it is generally covered with a thin *Film*; ſo, I ſuppoſe, in Evaporation of the *Natron*, ſome Parts of the Water being flown away, the Particles of the *Sal-Marine* branch one into another, and ſo incruſtate upon the Surface of the Water.

In this *Hypotheſis* I was the farther confirmed by this Experiment: I took ſome of the *Natron* and diſſolved it in Water, and ſet it to evaporate; and I found that the *Salt* did not incruſtate upon the Water, till three parts of the Water was evaporated. It did not therefore ſeem probable, that the *Nitre* came all from the Bottom to the Top, and ſo was condenſed by the Heat of the Sun; but that they incruſtated, when the *Saline Particles* branched one into another, ſome of the Aqueous Parts being exhaled.

The Reaſon why its *Volatile Alkali*, in Evaporation, does not fly quite away, is, becauſe it is held there by the *Sal-Marine*.

By the Teſtimony of *Hippocrates*, *Galen*, *Mathiolus*, *Diaſcorides*, *Pliny*, and *Agricola*, it appears to have been of great Uſe in Phyſick. But here it is to be noted, that when *Nitre* is preſcribed by them, that *Nitre* which is an Ingredient of *Gun-Powder* is not to be underſtood.

Amongſt the *Moderns* we have this Account of it: M. *de Clos* is of the Opinion, that moſt of the *Mineral Waters* in *France* are impregnated with this ſort of *Nitre*, and that all their Cures are done by it.

Molenbrochius affirms a *Tincture* of *Aphronitrum* to be of wonderful Efficacy in Stone. This I rather credit, becauſe it is ſaid by *Junken* in his *Medicus*, the *Nitre* of *Nitria* is of ſo piercing a Spirit, that it doth not permit either Stone or Rock to be thereabout.

In treating of its Uſe in *Agriculture*, I think it convenient to premiſe one *Phænomenon* which is afforded in *Evaporation:* when the Salts had ſpread themſelves over the Water in an Ice, thoſe thin Plates, after a while, would ſpread and aſcend in perpendicular Lines to the very Top of the Glaſs: I do therefore conjecture, that *Nitre* may be ſaid to *fertilize* the Ground after this manner, its *Volatile* Particles being heated by ſome *ſubterraneous Fire*, or elſe by the Warmth of the Sun, they do quickly aſcend in the ſmall *Tubes* of the *Plant*; and ſo, by the *Elaſtick* Nature, carry along with them, or force before them, thoſe Particles which, as they differently convene together, conſtitute the different parts of the *Plant*.

Mund. Subter. Cap. de Nitro.

But this Conjecture will be made ſomething the more probable, by an Experiment in *Kircher*; where he ſays, if you take a wooden Tube, and put into it *Tartar*, *Quick-lime*, *Salt*, and the *Urine* of a *Wine-Drinker*, reduced into one Maſs, which is to be hardened in the Sun; and after that ſet it in a cold Cellar, by the help of *Salt-Petre* from the before-mentioned Maſs, you will, not without Admiration, ſee Flowers branch out of it. Yea, ſuch is the Force of *Nitre*, that, if in a Glaſs kept cloſe ſhut, you put the Juices of ſome *nitrous Herbs* on the before-mentioned Maſs, the *Nitre* contained within it, being pregnant with Spirit, will force itſelf thro' the very Pores of the Glaſs.

M. *de la Chambre* ſays, *Plants* do grow in *Ægypt* in ſuch abundance, that they would choak one another, if they were not hindered by throwing Sand upon the Fields; inſomuch that the *Ægyptians* muſt take as much pains to leſſen the Fatneſs of their Lands, as other Nations do to encreaſe the Fatneſs of it.

Cap. de Vitri *Invent.*

In *Mechanicks*, we have this Account of it: It's ſaid by *Pliny*, that a Company of Merchants being thrown upon a Shore where there were not any Stones to be found, were forced to take great Pieces of *Ægyptian Nitre* out of their Ships and make Walls, upon which they hung their boiling Kettle:

the *Nitre* being heated by the Fire, mixed with the Sand, and ran into ſeveral Streams of Glaſs, which afterwards hinted the way of making Glaſs. It is likewiſe of uſe in Dying, for *Pliny* and *Vitruvius* affirm, That, by the help of this, the true *Azure* is made; and that without this, there cannot be a true Shadow.

This *Nitre* is diſtinguiſh'd from *Salt Petre*, 1. By its *fermenting:* It will *ferment* with any *Acid*, but *Salt-Petre* will not. I found that it would *ferment* with *Vinegar*, as the old Commentators obſerve in their Comments upon *Jeremiah* and the *Proverbs*, but *Salt-Petre* will not: which gave Occaſion to ſome, in thoſe Texts, to alter the Word *Nitre*.

2. It may be diſtinguiſhed from *Salt-Petre* in its Taſte; for *Natron* hath a *Lixivial* Taſte, but the other not.

3. By the *Volatile Spirit* which it affords: For from the one comes over a *Volatile Alkali*, but from the other a *Corroſive Acid*.

4. The *Natron* affords a red clammy Subſtance, inſipid, but the other not. This clammy Subſtance (if I miſtake not) is that which by *Pliny* is call'd *Ærugo Salis:* This it hath from the Earth, and therefore it is again ſaid by *Pliny*, *Sunt ibi* Nitrariæ *in quibus &* Rullum *exit a Colore* Terræ.

5. Like *Salt Petre* it will not *Chryſtallize*.

6. In the Fire, it makes no *Detonation*.

But in this it reſembles *Salt-Petre*; as that, by the Flowers of Sulphur, is made into a *Sal Prunellæ*, ſo this, if you drop Spirit of *Sulphur* upon it, ſhoots into *Pyramidal Salt*, that is not by the Taſte diſtinguiſhable from *Sal Prunellæ*, though its Taſte before was *Lixivial*.

From *Sal-Armoniack* it may be diſtinguiſhed: Firſt, by its Colour; for the *Natron* is ruddiſh, the other not: Secondly, by the Texture of its Parts; in *Sal-Armoniack*, the Parts ſeem cloſe and firmly knit together, but the *Natron* is ſpongy and perforated: Thirdly, if mixed with *Sal-Armoniack*, the *Sal-Armoniack* emits the ſame Spirit, as it doth, when mixed with *Quick Lime*.

But I think it comes much nearer to the Nature of *Sal-Armoniack* than *Salt-Petre*; 1*ſt*, Becauſe it is compoſed of a *Sea-Salt* and an *Urinous Alkali:* 2*dly*, Like *Sal-Armoniack*, when diſſolved in Water, it makes it extremely cold; and as *Franciſcus Hernandez* ſays, it produces the ſame Effect, when diſſolved in Wine. *Hiſt. of* Mexico.

The Original of the Nitre of Egypt; *by* Dr. Liſter, *n.* 167. *p.* 837.

2. The *Nitre* of *Egypt*, by the Experiments made about it at *Oxford*, plainly appears to be little different from *Sal-Armoniack:* and conſidering that it rains little or nothing, comparatively to the great Heats, in *Egypt*; and that the Lakes there are only once a Year furniſhed with freſh Water from the Overflowings of the *Nile*; alſo that vaſt Tracts of Land there, and all over *Aſia*, are naturally covered with *Foſſile Salt*; again, that thoſe Lakes are furniſhed with vaſt Animals, as *Crocodiles*, *Hippopotami*, and without doubt great Variety of other leſſer Vermin: theſe things, I ſay, well conſidered, it is eaſy to think, that in a Year's Time, moſt of the ſalt Water of thoſe Lakes has paſſed through the Bodies of thoſe Animals, and conſequently is become *Urinous* or *Salino-Urinous*, as is the Nature and Compoſition of *Factitious Sal-Armoniack*.

LXXXII. I am convinced that Sulphur is ſublimed from the Pyrites, according to the Opinion of Dr. *Liſter*; eſpecially that gathered upon Mount *Ætna*, *Veſuvius*, the *Solfatara*, and in the Stoves of *St. Gennaro*, not far from thence: for moſt of the Stones and Cinders, thrown out of thoſe mighty Furnaces, do manifeſtly contain Iron, if we may believe the *Magnet*. As to the Salt (taken by many Writers to be a ſort of *Sal Armoniack*) found together with the Sulphur in the forementioned Places, it appeared to me to be a kind of *Nitrum Calcarium*; for as I remember, it had not any *Urinous* Qualities, that I could perceive by ſlight Trials of Mixture; and I was the more confirmed in my Opinion, after I had ſeen and conſidered, the great Quantity of Lime-Stone round about *Naples*; many Beds of it lying up and down the *Terra di Lavoro*, or *Campania Felice*.

The Pyrites and Lapis Calcarius conſider'd; by Dr. Tanc. Robinſon. *n.* 169. *p.* 924.

LXXXIII. The Maſter of a *Copperas* Work at *Whiteſtable* in *Kent*, having engroſſed all the *Pyrites* or *Copperas Stones* to himſelf, laid up two or three hundred Tun in a Heap, and built a Shed over it to keep off the Rain; but in the ſpace of 6 or 7 Months it firſt ſmoaked, and then took fire, and burnt for a Week. Some of it looked like melted Metal, and other Parts like red-hot Stones; and it diſcharged ſo fetid, ſulphureous, or ſtinking Exhalations, that the People in the Neighbourhood were miſerably afflicted, and forced to uſe all their Endeavours to extinguiſh it.

The Spontaneous Firing *of the* Pyrites; *By Dr.* Fred. Slare, *n.* 213. *p.* 218.

LXXXIV. The *Mineral* out of which Brimſtone and Vitriol are extracted is one and the ſame, not much unlike Lead-Ore, having alſo ſometimes Lead mingled with it, which is ſeparated from it by picking it out of the reſt. The Mines reſemble our *Engliſh* Coal Mines, dug according to the depth of the *Mineral*, 15, 20, or more Fathoms, as the Vein leads the Workmen, or the Subterranean Waters will give them leave.

A Mineral at Liege, *yielding* Brimſtone *and* Vitriol; *by Sir* Rob. Moray, *n.* 30. *p.* 45.

To make Brimſtone, they break the Stone or Ore into ſmall Pieces, which they put into *Crucibles*, made of Earth 5 Foot long, Square and Pyramidwiſe; the Entry is near a Foot-ſquare. Theſe *Crucibles* are laid ſloping, eight undermoſt, and ſeven above them, as it were betwixt them, that the Fire may come at them all, each having its particular Furnace or Oven. The Brimſtone being diſſolved, by the Violence of the Heat, drops out at the ſmall End of the *Crucible*, and falls into a Leaden Trough or Receptacle, common to all the ſaid *Crucibles*, through which there runs a continual Rivulet of cold Water, conveyed thither by Pipes, for the cooling of the diſſolved *Sulphur*, which is ordinarily four Hours in melting. This done, the Aſhes are drawn out with a crooked Iron, and being put into an Iron Wheel-Barrow, are carried out of the Hutt, and being laid in a Heap, are covered with their other elixed or drained Aſhes, the better to keep them warm; which is reiterated as long as they make Brimſtone.

To make *Copperas* or *Vitriol*, they take a quantity of the ſaid Aſhes, and throwing them into a ſquare planked Pit in the Earth, ſome four Foot deep and eight Foot ſquare, they cover the ſame with ordinary Water, and let it lie 24 Hours, or until an Egg will ſwim upon the Liquor, which is a ſign that it is ſtrong enough. When they will boil this, they let it run though

Pipes into the Kettles, adding to it half as much *Mother-Water*, which is that Water which remains after the Boiling of the *Hardened Copperas*. The Kettles are made of Lead 4½ Foot high, ſix Foot long, and three Foot broad, ſtanding upon thick Iron Bars or Grates. In theſe the Liquor is boiled with a ſtrong Coal Fire, twenty-four Hours or more; according to the Strength or Weakneſs of the *Lee* or *Water*. When it is come to a juſt Conſiſtence, the Fire is taken away, and the boiled Liquor ſuffered to cool ſomewhat, and then it is tapped out of the ſaid Kettles through Holes beneath in the ſides of them, and conveyed through Wooden Conduits into ſeveral Receptacles, three Foot deep and four Foot long (made and ranged not unlike our Tan-Pits) where it remains 14 or 15 Days, or ſo long till the *Copperas* ſeparates itſelf from the Water, and becomes icy and hard. The remaining Water is the above-mention'd *Mother-Water*; and the elixed or drained Aſhes are the Dregs, or *Caput Mortuum*, which the *Lee*, whereof the *Vitriol* is made, leaves behind it in the planked Pits.

Sulphur, Vitriol, Alum, and Minium, from a Stone in Sweden; By Sir Gilb. Talbot, n. 21. p. 375.

LXXXV. 1. There is a *Stone* in *Sweden* of a yellow Colour, intermixed with Streaks of white, (as if compoſed of Gold and Silver) and heavy withal. It is found in firm Rocks, and runs in Veins, upon which they lay Wood and ſet it on fire. When the *Stone* is thus heated, they caſt Water upon it, to make it rend, and then dig it up with Mattocks. This done, they break it into ſmaller Pieces, and put it into Iron Pots, of the Shape repreſented by *Fig.* 153. the Mouth of the one going into the other. Then they place the one in the Oven upon an Iron Fork ſloping, ſo that the *Stone* being melted, it may run into the other, which ſtands at the Mouth of the Oven, ſupported upon an Iron. The firſt running of the *Stone* is *Sulphur*.

Fig. 153.

The remainder of the burned *Stone* is carried out, and laid upon a high Hill, where it lies expoſed to the Sun and Air for the ſpace of two Years; and then taketh fire of itſelf, caſting forth a thin blue Flame, ſcarce diſcernible in the Day-time. This being conſumed, leaveth a blue Duſt behind it; which the Workmen obſerve, and mark with Wooden Pins. This they dig up, and carry it into the Work-Houſe, and put it into great *Tubs* of *Water*, where it infuſeth 24 Hours, or more. The *Water* they afterward boil in Kettles, as we do *Salt-Petre*, and put it into cooling Tubs, wherein they place croſs Sticks, and on them the *Vitriol* faſtens, as *Sugar-Candy* doth.

The Water that remains after the Extraction of the *Vitriol* they mix with an 8th part of *Urine* and the *Lees* of Wood-Aſhes, which is again boiled very ſtrong, and being ſet to cool in Tubs, croſs Sticks are likewiſe faſtened, and thereon the *Alum* faſtens.

In the Water, which remains after the *Alum*, is found a *Sediment*, which being ſeparated from the Water, is put into an Oven, and Wood laid upon it and fired, till it become red, which makes the *Minium*, wherewith they paint their Houſes, and make Plaiſter.

The ſame in England; By . . . ib. p. 376.

2. There is a kind of *Stone* in the North of *England*, yielding the ſame Subſtances, except *Minium*.

LXXXVI. *Copperas Stones*, which ſome call *Gold Stones*, are found on the Sea-Shore in *Eſſex*, *Hampſhire*, and ſo Weſtward. There are great Quantities in the Cliffs; but not ſo good as thoſe on the Shore, where the *Tides* ebb and flow over them.

Green Copperas Works; By Mr. Daniel Colwal, *n.* 142. *p.* 1056.

The beſt of them are of a bright ſhining Silver Colour; the next ſuch as are of a ruſty deep Yellow; the worſt ſuch as have Gravel and Dirt in them, of a ſadder *Umber* Colour.

In the midſt of theſe Stones, are ſometimes found the Shells of *Cockles*, and other ſmall *Shell-Fiſhes*; ſmall Pieces of the Planks of Ships, and Pieces of Sea-Coal.

In order to the making of *Copperas*, they make Beds according as the Ground will permit; thoſe at *Deptford*, are about 100 Feet long, 15 Feet broad at the top, and 12 Foot deep, ſhelving all the way to the bottom.

They ram the Bed very well, firſt with ſtrong Clay, and then with the Rubbiſh of *Chalk*, whereby the Liquor, which drains out of the Diſſolution of the Stones, is conveyed into a Wooden ſhallow Trough, laid in the middle of the Bed, and covered with a Board; being alſo boarded on all ſides, and laid lower at one End than the other, whereby the Liquor is conveyed into a Ciſtern under the Boiling-Houſe.

When the Beds are indifferently well dried, they lay on the Stones about two Feet thick.

Theſe Stones will be five or ſix Years before they yield any conſiderable quantity of Liquor; and before that, the Liquor which they yield is but weak.

They ripen by the Sun and Rain: Yet Experience proves, that the Watering the Stones, although with Water prepared by lying in the Sun, and poured through very ſmall Holes of a Watering-Pot, doth retard the Work.

In time theſe Stones turn into a kind of *Vitriolick Earth*, which will ſwell and ferment like Leavened Dough.

When the Bed is come to Perfection, then once in four Years they refreſh it, by laying new Stones on the top.

When they make a new Bed, they take a good quantity of the old fermented Earth, and mingle it with new Stones, whereby the Work is haſtened. Thus the old Earth never becomes uſeleſs.

The Ciſtern before-mentioned is made of ſtrong Oaken Boards, well jointed and calked. That at *Deptford* will contain 700 Tuns of Liquor. Great care is to be taken, that the Liquor doth not drain through the Beds, or out of the Ciſtern. The beſt way to prevent the ſame, is to divide the Ciſtern in the Middle, by Oaken Boards, calked as before; whereby one of m may be mended in caſe of a Defect.

The more Rain falls, the more but the weaker will be the Liquor; the oodneſs whereof is tried by Weights prepared for that Purpoſe. Fourteen nny-Weight, is Rich; or an Egg being put into the Liquor, the higher ſwims above the Liquor, the ſtronger it is. Sometimes the Egg will ſwim ar half above the Liquor.

Within one Minute after an Egg is put in, the ambient Liquor will boil u froth; and in three Minutes the Shell will be quite worn off.

A Drop of this Liquor falling on the Manufactures of *Hemp*, *Flax*, or *Cotton Wool*, will preſently burn a Hole through it; as alſo in *Woollen* and *Leather*.

Out of the aforeſaid Ciſtern, the Liquor is pumped into a Boiler of Lead, about 8 Feet ſquare, containing about 12 Tuns, which is thus ordered. Firſt they lay long Pieces of Caſt Iron, 12 Inches ſquare, as long as the Breadth of the Boiler, about 12 Inches one from another, and 24 Inches above the Surface of the Fire. Then croſs-wiſe they lay ordinary flat Iron Bars, as cloſe as they can lie, the Sides being made up with Brick-work. In the middle of the bottom of this Boiler is laid a Trough of Lead, wherein they put at firſt 100 Pound Weight of old Iron.

The Fuel for boiling is *Newcaſtle Coals*. By degrees, in the boiling, they put in more Iron, amounting in all to 1500 Pound Weight in a Boiling. As the Liquor waſtes in boiling, they pump in freſh Liquor into the Boiler; whereby, and by a Defect in ordering the Fire, they were wont to be above 20 Days before it was enough; when that is, they try, by taking up a ſmall Quantity of Liquor into a ſhallow earthern Pan, and obſerving how ſoon it will gather and cruſt about the Sides thereof. But now of late, by the ingenious Contrivance of Sir *Nicholas Criſp*, the Work is much facilitated, for, at his Work at *Deptford*, they boil off three Boilers of ordinary Liquor in one Week; which is done, firſt by ordering the Furnace ſo, as that the Heat is conveyed to all Parts of the Bottom and Sides of the Furnace.

Then whereas they were wont to pump cold Liquor into the Boiler, to ſupply the Waſte in boiling, whereby the Boiler was checked ſometimes ten Hours, Sir *Nicholas* hath now a Veſſel of Lead, which he calls a Heater, placed at the end of the Boiler, and a little higher, ſupported by Bars of Iron as before, and filled with Liquor, which, by a Conveyance of Heat from the Furnace, is kept near boiling hot, and ſo continually ſupplies the Waſte of the Boiler, without hindring the boiling. *Thirdly*, By putting due Proportions of Iron from time to time into the Boiler; as ſoon as they perceive the Liquor to boil ſlowly, they put in more Iron, which will ſoon quicken it. Beſides, if they do not continually ſupply the boiling Liquor with Iron, the *Copperas* will gather to the Bottom of the Boiler, and melt it; and ſo it will do if the Liquor be not preſently drawn off from the Boiler into a Cooler, ſo ſoon as it is enough.

The Cooler is oblong, 20 Feet long, 9 Feet over at the top, 5 Feet deep, tapered towards the bottom, made of Tarras. Into this they let the Liquor run, ſo ſoon as it is boiled enough. The *Copperas* herein will be gathering or ſhooting 14 or 15 Days, and gathers as much on the Sides as in the bottom; *ſcil.* above 5 Inches thick. Some put Buſhes into the Cooler, about which the *Copperas* will gather, but at *Deptford* they make no Uſe of any.

That which ſticks to the Sides, and to the Buſhes, is of a bright green, that in the bottom of a foul and dirty Colour.

In the end of 14 Days they convey the Liquor into another Cooler, and reſerve it to be boiled again with new Liquor.

The *Copperas* they ſhovel on a Floor adjoining, ſo that the Liquor may drain from it into a Cooler.

The Steam, which comes from the Boiling, is of an acrimonious Smell.

Copperas may be boiled without Iron, but with difficulty; without it the Boiler will be in danger of melting.

Sometimes, in ſtirring the Earth upon the Beds, they find Pieces of *Copperas*, produced by lying in the Sun.

tOil *of* Vitriol *increaſing in* Weight; *by* *Dr.* Will. Gold, *n.* 156. *p.* 496.

LXXXVII. Some Druggiſts have accidentally taken notice of an Increaſe of Weight in *Oil* of *Vitriol* expoſed to the Air (and perhaps have improved it to their own Gain, though to the Detriment of the Buyer.) And the induſtrious Chymiſt Mr. *White*, the Univerſity-Operator at *Oxford*, had a Viol of that Liquor unſtopt and conſtantly running over: But ſince from thence no true Eſtimate of the *juſt Increaſe* could be collected, I ſhall here give you what has occurred more particularly on this Subject.

Vid. Sup. Cap. I. §. XVI.

Nov. 4. 1683. Three Drams of *Oil of Vitriol*, ſo far *dephlegmed* as to burn or *corrode* a ſtrong Packtread aſunder, was expoſed to the Air in a Marmalade Glaſs of three Inches Diameter, and placed in a nice Pair of Scales, in a Room where no Fire nor Sun came; its Increaſe for ſeven natural Days, divided by leſs Portions of Time, was according to the following Table.

Nov. 1683.		*Gain.*	*Space of Time.*	*Weather.*	*Wind.*	*Sum of Gain.*	*Natural Day.*
D.	*H.* 3.	℥ ℈. gr.	*H.*	*Moiſt.*		℥ ℈. gr.	
9	5 *p. m.*	3 0 00					
	11 *p. m.*	0 0 19	6 *h.*	*Moiſt and*	*Southerly.*		
10	8 *m.*	0 1 12	9	*Windy.*	*N. Weſterly.*		1*ſt.*
	11 *m.*	0 0 08	3	*Rainy Morn.*		1 0 08	
	5 *p. m.*	0 0 09	6	*Clear.*			
	11 *p. m.*	0 0 18	6	*Star-lig. Cold, bright Morn.*	*N. W.*	0 2 18	2*d.*
11	8 *m.*	0 1 07	9	*Mild.*			
	11 *m.*	0 0 04	3	*Mild, Dry*			
	5 *p. m.*	0 0 09	6	*Weather.*			
	11 *p. m.*	*fere* 0 10	6	*Mild, Dry,*	*N. W.*		
12	8 *m.*	0 0 17	9	*Clear Morn.*	*N.*	0 1 19	3*d.*
	11 *m.*	0 0 05	3	*Froſty.*	*N. more.*		
	5 *p. m.*	0 0 07	6	*Over-caſt.*	*W.*		
	11 *p. m.*	0 0 06	6	*Cloudy, Rain.*	*Weſterly.*		
13	8 *m.*	0 0 09	9				
	11 *m.*	0 0 03	3	*Cloudy.*	*S. W.*	0 1 3½	4*th.*
	5 *p. m.*	0 0 05½	6	*Mild.*			

14	11 *p. m.*	0 0 06	6	*Cloudy, Miſty.*	*S. E.*	0 0 18	5*th.*
	8 *m.*	0 0 08	9	*Cloudy, Miſty.*			
	11 *m.*	0 0 02½	3	*Miſty.*	*Southerly.*		
	5 *p. m.*	0 0 01½	6	*Very warm.*			
15	11 *p. m.*	0 0 02	6	*Cloudy, unuſually Warm.*	*More S.*	0 0 15	6*th.*
	8 *m.*	0 0 06	9	*Cloudy.*	*S. E.*		
	11 *m.*	0 0 03	3	*Cloudy Moiſt.*	*More S.*		
	5 *p. m.*	0 0 04	6	*Clear Coldiſh.*	*Eaſterly.*		
16	11 *p. m.*	0 0 04½	6	*Dry Starlight.*	*Eaſterly.*	0 0 17	7*th.*
	9 *m.*	0 0 09	10	*Cold, Cloudy but Cold.*			
	11 *m.*	0 0 02	2	*Cloudy, Windy.*	*S. E.*		
	5 *p. m.*	0 0 02	6	*Cl. very Mild.*			

From the 16th, in the ſucceſſive Spaces of 24 Hours, each gained one of the Number of Grains following; as the 8th natural Day gained 13½, the next 12; 9, 7, 6, 5, 5, 4½ 3, 3, 3, 3, 4, 3 (*Decemb.*) 4, 4½ 4, 3, 3, *&c.* ſtill irregularly decreaſing till the Liquor was ſatiated. The *Diary* was continu'd to *Jan.* 4. 168¾. when the Increaſe, in 24 Hours amounted ſcarce to half a Grain; and probably had the Weather been then dry, it might have been none at all, or rather the Liquor might have loſt what before it had gained.

Hence 'tis obvious, that the more our Liquor was ſaturated, the leſs was its daily Increaſe, though not gradually leſs by an even Deſcent each Day, but ſometimes two or more natural Days together it was exactly the ſame, a Day or two after leſs, and then again more the next Day following, according as the Liquor ſtood affected by the Heat and Cold, Drineſs or Moiſture of the Weather, the differing Time of the Day, and Quarter of the Wind. Thus upon the view of the whole Diary of almoſt two Months, it appeared, the Increaſe was more in a moiſt, rainy, miſty, and ſnowy, but leſs in a froſty, clear, and dry Seaſon; as alſo it was more in a cold than in a warm Air. When the Wind was Northerly or Eaſterly, the Gain was leſs, *cæteris paribus*, than when Southerly or Weſterly, and was leſs in the Day than in the Night. The primary Cauſe of this *Phænomenon* ſeems to be the Moiſture of the Air, which our Liquor (a potential Fire) imbibes as greedily, as actual Fire does the *Pabulum* of *Nitre*; yet we muſt allow that all the other Circumſtances of Seaſon, juſt now mentioned, have each their particular Influences in diverſifying the Quantity of the Increaſe. Thus it appears in the Table, that Heat alters the Progreſs of increaſing; for on the 14th of *Novemb.* from 11 *m.* to 11 *p. m.* (at which time, eſpecially towards Night) a very unuſual and troubleſome Heat in the Air was complained of by ſeveral here in *Oxford*; in 12 Hours the Gain was only 3 ½ *gr.* whereas, in the like time preceding, it was 10½ Grains, and in that juſt following 9 Grains.

Neither indeed can any thing otherwiſe be expected from Heat, ſince thereby the Moiſture might rather be exhaled, or at leaſt might be ſuſpended, agitated, and intimately mixed with the Subſtance of the Air, and conſequently not ſo eaſily be arreſted and entangled by the Surface of the Liquor, as when the Air is leſs hot. However, allowing the Effect of this *anomalous* Accident, at a time of the Year when leaſt expected, and conſidering that moſt commonly Heat keeps even pace with the Seaſon of the Year; depending, as to its Temper, for the moſt part, on the Nearneſs or Remoteneſs of the Sun: we may ſafely conclude, Moiſture the chief and only Cauſe of the Increaſe of Weight in *Oil of Vitriol*, ſince in dry clear Weather it conſtantly increaſes leſs than in moiſt and cloudy; the Circumſtance of Heat or Cold remaining the ſame in both.

But this will be clearly evinced, by an Inquiry made into the Nature of the Subſtance gained with the Increaſe of Weight: For by the ordinary ways of Trial it appeared, the *Atmoſphere* afforded our Liquor nothing beſides ſome of its *Watry Particles*, wherewith it always abounds; but more eſpecially is ready to part with in moiſt Weather.

The Air, without doubt, has great Variety of different Subſtances floating in it, whereof ſome Particles do adhere to this, ſome other ſort to that Body, according as either is peculiarly diſpoſed to receive one ſort rather than another. Thus the Mortar in the Joints of old Walls and Vaults, from Corpuſcles attracted from the Air, ſpouts out and frames a peculiar kind of Salt. I have known a Deal Shelf, moiſtened only with the Liquor of *fixed Nitre*, froſted over with *Chryſtals* of a perfect *inflammable Nitre*, by regaining the proper *Acids* from the Air, all one as if ſo much Spirit of *Nitre* had been poured on the ſaid Liquor. I have ſeen a Viol half filled with *Oil* of *Tartar per Deliquium* (by being left open to the Air) beſet above the Liquor with peculiarly figured Chryſtals, and at the bottom were flat Chryſtallized Plates of a Salt, which without Flame, crackled on a live Coal, and left behind a *Calx* much like Dr. *Liſter*'s *Nitrum Calcarium*. And 'tis well known *Colcothar* of *Vitriol*, reimpregnated by the Air, will, by a freſh Diſtillation, give you its proper *Acid* as at firſt. Now upon ſuch Hints as theſe, ſome (fond of the Doctrine of *Alcali* and *Acid*) might perhaps expect, ſince differing Bodies of an *Alcalizate* Nature do thus regain their proper *Acids*, that, *vice verſa*, even this moſt *Acid* Liquor, *Oil* of *Vitriol*, alſo might find its *Alcalizate* Aſſociate in the Air, from which the Violence of Fire had before driven it. But we could diſcover no ſuch Matter; the Taſte of our augmented Liquor was ſtill purely *Acid*, and only weaker than before; whereas it would have been ſaltiſh, had an *Alcali* been combined with it, and its Colour, from a deep reddiſh, became *limpid*, all one as if the like Quantity of fair Water had been mixed. But to be more certain in this Point, I diſtilled of the new-gained Subſtance: At firſt it came over as inſipid as clear water; and urging the Fire farther, the Drops proved ſour, and the remaining *Oil* in the *Retort* was altogether as *corroſive* as at firſt. Whence we may infer, its Edge was not at all blunted by any adjoined *Alcali*; ſo that what the Air afforded, was nothing elſe but mere *Water* only.

As to the Quantity of the whole Increaſe, it can't be determined by any general Rule, ſince it varies according to the different Strength of the *Oil* of *Vitriol*; for it appears by the Table, the more diluted the Liquor, the leſs attractive it proved. This here employ'd (as highly dephlegm'd, I preſume, as any uſually is) gave a Triple, and more than $\frac{1}{6}$ of its firſt Weight, amounting in all from 3 to 9 *Drams*, and 30 *Gr.* before it came to a Stand.

Which Proportion of *Increaſe* I found confirmed in leſſer Quantities alſo; as 3 *gr. increaſed* to more than 9 *gr.* and *one Grain* gave the *Weight* of ſomewhat more than 3 *Grains.* But beſide the Strength of the Liquor, there are other Circumſtances, as the Seaſon of the Year, and Poſition of the Place, which will certainly ſomething alter this Point; thus our Liquor will gain more in *Winter* than in *Summer*, more in a *Cellar* and *Sun-leſs Room*, than in a Room not ſo *qualified.*

All theſe Circumſtances, which relate to the Quantity, will alſo influence very much the Time of the *Increaſe*, but what makes the moſt peculiar and principal Variation in this Point, is the *Proportion* of the *Surface* to the *Bulk* of the *Liquor*. For I find the greater or leſs the *Surface* is, the quicker or ſlower the *Increaſe.* Thus 3 *Grains* dropt and diffuſed to near $\frac{3}{4}$ Inch breadth on a Piece of Glaſs, gained 3 *Gr.* in 6 Hours; 1 *Gr.* in 6 more; 1 *Gr.* and $\frac{1}{2}$ in 12 Hours more; in the next 12 Hours it gained $\frac{1}{2}$ *Gr.* and in the laſt 12 Hours it gained very little obſervable: So that in leſs than 48 Hours, having more than triple its firſt Weight, it was for ſome time fully ſatiated, till rainy Weather added ſomething more.

But to diſcover more nicely what Intereſt the Proportion of Surface has in haſtening or retarding the Increaſe of *Weight*, I expoſed in the ſame Room, and to the ſame Temper of the *Air* (as near as I could gueſs) 3 *Drams* of the ſame *Oil* of *Vitriol* in an open flat Glaſs one Inch broad, being only $\frac{1}{3}$ of the *Diameter* of that Glaſs uſed at firſt with the like Quantity. The Reſult was this; That whereas the other Surface of 3 Inches *Diameter*, gained (as in the *Table*) near 19 *Gr.* the firſt 6 Hours, this leſs Surface gained a very little perceiveable more than 2 *Grains* in the ſame Space of Time. Now ſince the *Area's* of *Circles* are to one another as the Squares of their reſpective Diameters; as 1 the Square of the leſs, is to 9 the Square of the greater Glaſs's Diameter, ſo was the Weight of a little more than 2 *Grains* gained in the narrower Glaſs, to near 19 *Gr.* gained in the broader: Wherefore the *Time* of Increaſing bears, as near as can be expected, an exact Proportion to the Surface of the Liquor expoſed, and the Liquor in the leſſer Glaſs having but $\frac{1}{9}$ part of the Surface of the greater, could not be ſatiated under 9 times as many Days as the greater.

White Vitriol, by Dr. Liſter, *n.* 256. *p.* 331. LXXXVIII. All I can find of the *Origin* of *White Vitriol* is out of *Borrichius de Docimaſtice Metallica*, that it is produced from a certain *Lead Ore* boiled raw. (*Plumbi Nigri Vena* Nitriolum Album *producit*, *etiam non cremata.*) None that I know of our *Engliſh Lead Ores* gives us any ſuſpicion of any ſuch *Vitriol.* It is true, I have by me ſome ſorts of *White Lead Ore*, *Spar-like*, plentifully yielding *Lead*; but I cannot ſay, that either thoſe, or any coloured *Lead Ores*, did give me any Reaſon to ſuſpect, after divers Experiments upon them, that they yield *white Vitriol.*

As to the *Chryſtals* of *white Vitriol*, they are very difficult to deſcribe, and ſeem to me to be a Congeries of infinite ſmall Needles; for which reaſon they are of a moſt ſpeedy Operation, and irritate the Stomach ſuddenly, before they can be well diſſolved or broken.

Alum Works; by Mr. Dan. Colwal, *n.* 142. *p.* 1052.

LXXXIX. *Alum* is made of a Stone, of Sea-Weed and Urine.

The *Stone* is found in moſt of the Hills between *Scarborough* and the River of *Tees* in the County of *York*; as alſo near *Preſton* in *Lancaſhire*. It is of a blueiſh Colour, and will cleave like *Corniſh Slate.*

The Mine, which lies deep in the Earth, and is indifferently well moiſtned with Springs, is the beſt. The dry Mine is not good; and too much Moiſture cankers and corrupts the Stone, making it nitrous.

In this Mine are found ſeveral Veins of Stone called *Doggers*, of the ſame Colour, but not ſo good. Here are alſo found thoſe that are commonly called *Snake-Stones*; the People have a Tradition, That the Country thereabouts being very much annoyed with Snakes, by the Prayers of St. *Hilda*, there inhabiting, they were all turned into Stones, and that no *Snake* hath ever ſince been ſeen in thoſe Parts.

For the more convenient working of the *Mines*, which ſometimes lie 20 Yards under a Surface or Cap of Earth, (which muſt be taken off and barrowed away) they begin their Work on the declining of a Hill, where they may be alſo well furniſhed with Water. They dig down the Mine by Stages to ſave Carriage, and ſo throw it down near the Places where they calcine it.

The Mine before it is calcined being expoſed to the Air; will moulder in Pieces, and yield a Liquor whereof *Copperas* may be made: But being calcined, it is fit for *Alum.* As long as it continues in the Earth, or in Water, it remains a hard Stone.

Sometimes a Liquor will iſſue out of the Side of the Mine, which by the Heat of the Sun is turned into natural *Alum.*

The *Mine* is calcined with *Cinders* of *Newcaſtle Coal*, *Wood* and *Furzes*; the Fire made about 2 Feet and an half thick, 2 Yards broad, and 10 Yards long. Betwixt every Fire are Stops made with wet Rubbiſh, ſo that any one or more of them may be kindled, without Prejudice to the reſt.

After there are 8 or 10 Yards *thickneſs* of broken *Mine* laid on this Fewel, and 5 or 6 of them ſo covered; then they begin to kindle the Fires, and as the Fire riſes towards the top, they ſtill lay on freſh *Mine*: So that to what Height you can raiſe the Heap, which is oftentimes about 20 Yards, the Fires without any further help of Fewel will burn to the top ſtronger than at the firſt Kindling, ſo long as any Sulphur remains in the Stones.

In calcining theſe Stones, the Wind many times does hurt, by forcing the Fire in ſome Places too quickly through the Mine, leaving it black and half burnt, and in others burning the Mine too much, leaving it red. But where the Fire paſſeth ſoftly and of its own accord, it leaves the Mine white, which yields the beſt and greateſt quantity of Liquor.

The *Mine* thus calcined, is put into Pits of Water, ſupported with Frames of Wood, and rammed on all Sides with Clay, about 10 Yards long, 5 Yards broad, and 5 Feet deep, ſet with a Current, that turneth the Liquor into a *Receptory*, from whence it is pumped into another *Pit* or *Mine*; ſo that every Pit of Liquor, before it comes to the boiling, is pumped into 4 ſeveral Pits of Mine; and every Pit of Mine is ſteeped in 4 ſeveral Liquors, before it be thrown away, the laſt Pit being always freſh Mine.

This *Mine* thus ſteeped in each of the ſeveral Liquors 24 Hours or thereabout, is of courſe 4 Days in paſſing the 4 ſeveral Pits, from whence the Liquors paſs to the Boiling-Houſe.

The *Water* or *Virgin-Liquor*, oft-times gains in the firſt Pit, 2 Pound Weight. In the 2*d* it increaſeth to 5 Pound Weight; in the 3*d* to 8 Pound Weight; and in the laſt Pit, which is always freſh *Mine*, to 12 Pound Weight, and ſo in this Proportion, according to the Goodneſs of the Mine, and the well calcining thereof. For ſometimes the Liquors paſſing the 4 ſeveral Pits, will not be above 6 or 7 Pound Weight; at other times above 12 Pound Weight, ſeldom holding a conſtant Weight one Week together. Yet many times Liquor of 7 or 8 Pound Weight produceth more *Alum* than that of 10 or 12 Pound Weight, either thro' the Illneſs of the *Mine*, or, as uſually, the bad calcining thereof. And if by paſſing the weak Liquor thro' another Pit of freſh *Mine*, you bring it to 10 or 12 Pound Weight; yet you ſhall make leſs *Alum* with it, than when it was but 8 Pound Weight. For what it gains from the laſt Pit of *Mine*, will be moſt of it *Nitre* and *Slam*, which poiſons the good Liquors, and diſorders the whole Houſe, until the *Slam* be wrought out.

That which they call *Slam*, is firſt perceived by the Redneſs of the Liquor when it comes from the Pit, occaſioned either by the Illneſs of the Mine, or, as commonly, the over or under calcining it, as abovesaid; which in the Settler ſinks to the Bottom, and there becomes of a muddy Subſtance, and of a dark Colour. That Liquor which comes whiteſt from the *Pits*, is the beſt.

When a Work is firſt begun, they make *Alum* of the Liquor only that comes from the Pits of Mine, without any other Ingredients; and ſo might continue, but that it would ſpend ſo much Liquor as not to quit Coſt.

Kelp is made of a *Sea-Weed* called *Tangle*, ſuch as comes to *London* on *Oyſters*. It grows on Rocks by the Sea-Side, between High-Water and Low-Water Mark. Being dried, it will burn and run like *Pitch*; when cold and hard, it is beaten to *Aſhes* ſteeped in Water, and the *Lees* drawn off to 2 Pound Weight, or thereabouts.

Becauſe the Country-People, who furniſh the Work with *Urine*, do ſometimes mingle it with Sea-Water, which cannot be diſcovered by Weight, they try it, by putting ſome of it to the boiling Liquor; for ſo, if the *Urine* be good, it will work like *Yeaſt* put to *Beer* or *Ale*, but if mingled, it will ſtir no more than ſo much Water.

It is obſerved, that the beſt *Urine* is that which comes from poor labouring People, who drink little ſtrong Drink.

The *boiling Pans* are made of *Lead*, 9 Feet long, 5 Feet broad, and 2 and a half deep, ſet upon Iron Plates about 2 Inches thick, which *Pans* are commonly new caſt, and the Plates repaired 5 times in 2 Years.

When the Work is begun, and *Alum* once made, then they ſave the Liquor which comes from the *Alum*, or wherein the *Alum* ſhoots, which they call *Mothers*; with this they fill 2 third parts of the *Boilers*, and put in one third Part of freſh Liquor which comes from the Pits. Being thus filled up with cold Liquor, the Fires having never been drawn out, will boil again in leſs than 2 Hours time; and in every 2 Hours time the Liquor will waſte 4 Inches, and the Boilers are filled up again with green Liquor.

The Liquor, if good, will in boiling be greaſy, as it were, at the Top: If nitrous, it will be thick, muddy, and red. In boiling 24 Hours, it will be 36 Pound Weight, then is put into the *Boiler* about a Hogſhead of the *Lees* of *Kelp*, of about 2 Penny-Weight, which will reduce the whole *Boiler* to about 27 Pound Weight.

If the Liquor is good, as ſoon as the *Lees* of *Kelp* are put into the Boiler, they will work like *Yeaſt* put to *Beer*; but if the Liquor in the Boiler be nitrous, the *Kelp Lees* will ſtir it but very little: And in that caſe, the Workmen muſt put in the more and ſtronger *Lees*.

Preſently after the *Kelp Lees* are put into the *Boiler*, all the *Liquor* together is drawn into a *Settler*, as big as the *Boiler*, made of *Lead*, in which it ſtands about 2 Hours, in which time moſt of the *Nitre* and *Slam* ſink to the Bottom.

This Separation is made by means of the *Kelp Lees*, for when the whole *Boiler* conſiſts of green Liquor drawn from the Pits, it is of a Power ſtrong enough to caſt off the *Slam* and *Nitre*; but when the *Mothers* are uſed, the *Kelp Lees* are needful to make the ſaid Separation.

Then the ſaid Liquor is ſcooped out of the *Settler*, into a *Cooler* made of *Deal-Boards*, and rammed with *Clay*. In this is put 20 *Gallons* or more of *Urine*, more or leſs according to the *Goodneſs* or *Badneſs* of the *Liquor*; for if the *Liquor* be red, and conſequently *Nitrous*, the more *Urine* is required.

In the *Cooler*, the *Liquor* in temperate Weather ſtands 4 Days. The 2d Day the *Alum* begins to ſtrike, gather and harden about the Sides, and at the Bottom of the *Cooler*.

If the Liquor ſhould ſtand in the *Cooler* above 3 Days, it would, as they ſay, turn to *Copperas*.

The Uſe of *Urine*, is as well to caſt off the *Slam*, as to keep the *Kelp Lees* from hardening the *Alum* too much.

In hot Weather the *Liquors* will be one Day longer in cooling, and the *Alum* in gathering, than when the Weather is temperate. In froſty Weather, the Cold ſtrikes the *Alum* too ſoon, not giving time for the *Nitre* and *Slam* for to ſink to the Bottom, whereby they are mingled with the *Alum*. This produceth double the Quantity, but being foul, is conſumed in the waſhing.

When the *Liquor* hath ſtood 4 Days in the *Cooler*, then that called *Mothers* is ſcooped into a Ciſtern, the *Alum* remaining on the Sides, and at the Bottom; and from thence the *Mothers* are pumped back into the *Boiler* again. So that every 5 Days the *Liquor* is boiled again, until it evaporate or turn into *Alum* or *Slam*.

The *Alum* taken from the Sides and Bottom of the Cooler, is put into a Ciſtern and waſhed with Water that hath been uſed for the ſame Purpoſe; being about twelve Pound Weight. After which it is roached, as followeth.

Being waſhed it is put into another Pan with a Quantity of Water, where it melts and boils a little. Then it is ſcooped into a great Caſk, where it commonly ſtands 10 Days, and is then fit to take down for the Market.

The Liquors are weighed by the Troy-Weight; ſo that half a Pint of Liquor muſt weigh more than ſo much Water, by ſo many Penny-Weight.

Experiments about Vitriol, Sulphur, and Alum; By . . n. 103. p. 41.

XC. *Vitriol* is of ſeveral Kinds, being for Colour, *White*, *Yellow*, *Green*, or *Blue*; uſually of the two laſt mentioned: And is made either of *Mineral Waters*, boiled up to a convenient Conſiſtence; then ſet to *Chryſtallize*: Or extracted by common Water out of Earths impregnated therewith. 'Tis alſo afforded by many ſorts of Stones, commonly called *Pyrites* and *Marchaſites*, which expoſed ſome Months to *Aerial* Influences, are reſolved into Powder, and the Saline Part diſſolved in Rain or other Water; then boiled and ſet to ſhoot, yield ſtore of *Vitriol*, eſpecially with the Addition of *Copper* or *Iron*. It is often aſſociated with Earth and Stones, wherein Metals are contained; and with many natural Recrements of Metals, ſuch as *Miſy*, *Sory*, *Chalcitis*; from which 'tis uſually ſeparable by the common Method with water, ſometimes not to be extricated until the *Mineral* be firſt calcined or burnt. It is alſo frequently found pure and perfect in the Caverns of the Earth, being an *Efflore ſcence* of ſeveral *Minerals*; and this is accounted by all *Naturaliſts*, the beſt, both for *Medicinal* and *Spagyrical* Uſes. Laſtly, it is copiouſly contained in common *Mineral Sulphur*.

Vitriol conſiſts of *inſipid Phlegm*, *Earth*, or *Oker*, ſome *Metal*, *Mineral Sulphur*, an *Acid Salt* or *Spirit*, together with ſome ſmall Portion of the *Volatile Aerial Salt.* That it contains Water, needs no great Proof, ſince no Saline Subſtance can *Chryſtallize* without it; and Diſtillation will convince any Perſon, that it exceeds in Quantity any of the other Principles.

The *Earth* or *Oker* may be thus ſeparated. Diſſolve *Vitriol* in fair Water, immediately a yellow Powder will ſeparate, and in a ſhort Time ſubſide. The greater the Quantity of Water imployed, the more *Oker* precipitates: The weaker the *Lixivium*, the leſs able to ſupport Bodies more ponderous than common Water; and the lighter the Water (as if diſtilled Rain-water, or *Phlegm* of *Vinous Spirits*) the more *Earthy* Parts ſubſide, upon the ſame *Hydroſtatical* Principle. I have above 20 times repeated this Diſſolution, ſeconded by *Filtration* and *Coagulation*, and each time ſeparated ſome Quantity of this Earth: And I am perſuaded, had I long continued the Operation, the Succeſs would have been the ſame, only I obſerved the Quantity ſeparated each time, ſenſibly to diminiſh. But I have found a more eaſy and expedite way of effecting this Separation: Take a good Quantity of the common *Dantzick* or *Hungarian Vitriol*; having powdered it, put it into a ſlender *Cucurbite*; place it in Water, keep under it an equal conſtant Fire 3 or 4 Days: The *Vitriol* will, without Additament, become fluid, as if diſſolved in *Water*, and the *Oker* with moſt of the *Metalline* Parts, with the groſs *Sulphur*, will ſubſide, and become a hard Cake at the Bottom, the *Vitriol* being fluid about it, which in the Cold again *Chryſtallizeth*; excepting a ſmall Quantity of *Liquamen*, of the ſame Nature with that we ſhall hereafter mention. This repeated once or twice, the *Vitriol* attains unto a high degree of Purity, and is eaſily capable of many Alterations, whereunto it was not ſubject before this Purification. This Operation will not ſucceed in a dry Digeſtion; I mean, *Aſhes*, *Sand*, *Filings* of *Iron* or *Steel*, *open Fire*, or even *Flame* of *Lamps*, whether fed with *Oil* or *Spirit* of *Wine*. This *Earth* may be alſo obtained in a great Proportion, though in another Form, if after a long and intenſe *Calcination*, the *Vitriol* is freed from its remaining Salt, by frequent *Ablutions* with warm *Water*: The far greateſt Part of this *Dulcified Colcothar* is *Inſipid Earth* with ſome ſmall Proportion of *Metal*. The ſame may be *precipitated* by *Salt* of *Tartar*, or any other *Alcalies*, or *Filings* of *Zink*, or other immature *Minerals*, out of a Solution of *Vitriol* in common *Water*. It being alſo ſeparated from *Metalline* and *Saline* Parts, by a Method I ſhall hereafter mention, there remains a great Quantity of an *Inſipid* Subſtance nearly reſembling *Burnt Alum*. Beſides, whereas *Salt*, *Nitre*, *&c.* require in *Diſtillation* a large Quantity of *Earthy* Subſtance to disjoin the *Saline* Parts, and prevent *Fuſion*; *Vitriol* and *Alum* need it not: an unqueſtionable Proof, that *Earthy* Parts abound therein.

That *Vitriol* contains Sulphur, is evinced by the ſulphureous Smell it emits in *Diſtillation*, eſpecially if urged with a ſtrong Fire from the Beginning; and the Spirit thus drawn being rectified, the Liquor, which firſt riſes, hath a highly ſulphureous Smell; as hath alſo that we ſhall hereafter mention, diſtilled from *Vitriol* deprived of its *Metallick* Parts. The *Colcothar Dulcified*, or *Metallick* Parts precipitated by an *Alcali*, or *Immature Mineral ſublimed* with *Sal Armoniack*; an *Inflammable* Sulphur may be many ways ſeparated, both from the *Sublimate* and *Caput Mortuum*. The common Oil of *Vitriol* digeſted on *Antimony*, then diſtilled, yields a much greater Quantity of Sulphur, than would have been produced had any other *Acid* Liquor been employed; and the ſame Oil of *Vitriol* digeſted with *Spirit* of *Wine*, and diſtilled, yields an Oil, and at the latter End, ſtore of ſulphureous inflammable Flowers.

As for the *Acid Saline* Principle, I ſuppoſe no Perſon who hath taſted of the Spirit of *Vitriol*, and that abuſively called its Oil, will queſtion its abounding in that Subject.

In order to the Reſolution of ſome Enquiries about the *Saline* Principle, I made theſe Experiments. I took 4 or 5 Gallons of the *Vitriolate Water*, which was conveyed by artificial Channels at *Deptford*, from the Beds of *Pyrites* or *Marchaſites* into the great Ciſtern. I diſtilled therefrom, in Glaſs Veſſels, two Thirds of *inſipid Water*; letting the Glaſſes cool, the *Water* let fall a *Vitriol* of a lovely dilute Colour, together with a great Quantity of that yellow Sediment which we formerly called *Oker*. Then evaporating a third Part of the remaining Liquor, I received more *Vitriol* of a paler Colour than the former, and *Oker* as before, though leſs. The 5th Time this

Operation was repeated, inſtead of *Vitriol* it afforded a Yellow, and ever after a *White Salt*, which did differ exceedingly from *Vitriol*, not only in Colour, but alſo in Taſte, being fiery and pungent; and did partake little of that abominable rough aſtringent Smack, which is peculiar to *Vitriol*. It was alſo *Unctuous*, like *Salt* of *Tartar*, made the Hands ſoft and ſupple, cleanſing like a *Sapo*, whereas common *Vitriol* renders them rough and harſh: Being diſſolved in *Water*, it appeared to the very Eye very *Fatty* and *Oleagenous*.

From 5 Pounds and an half of *Lixivium*, I received 4 Pounds of this fiery *White Salt*, beſides half a Pound of *Liquamen*, which remained fluid, and would not *coagulate*. I do the rather mention this, for that it is one of the moſt eminent Inſtances, I ever met withal, of ſo great a Quantity of Salt kept fluid in the Cold, by ſo ſmall a Quantity of *Water*.

The remaining *Liquamen* was very fiery, acidly pungent, and extremely ponderous; no whit inferiour, in my Opinion, in any of theſe Reſpects to common Oil of *Vitriol*: it ſeeming to me ſtrange and unuſual, that ſo ſtrong a Liquor ſhould be obtained without any conſiderable degree of Fire.

This *Liquamen* being expoſed to the Air, ſoon attracted double its Quantity of Moiſture: I cannot recollect, that I did ever obſerve any fluid Body, which approached near unto it for this Property; though I am not ignorant, that all *Corroſive Saline* Liquors will borrow conſiderably from their neighbouring Element. I always obſerved this *Liquamen* to acquire more or leſs Moiſture, according to the Conſtitution of the Seaſon, riſing ſenſibly in moiſt Weather, and little in dry.

The white Salt, laſt mentioned, was diſtilled in a Sand Furnace, and the far greater Part came over in the Form of a Spirit highly *Acid*, eſpecially that which came laſt in ſmall Drops. This Liquor rectified in a very tall Body immediately upon the Approach of the ſmalleſt Degree of Heat, a *Volatile Sulphureous* Spirit did ariſe as clear as Rock Water, almoſt, nay I think altogether *Inſipid*; yet the Smell ſo ſubtile and penetrating, that 'twas inſupportable: And ſuch it continued many Years, not letting fall any Sediment, and thereby loſing its Strength, as doth the *Volatile Spirit* made out of common *Vitriol*. The Spirit which remained after the Separation of the more *Volatile*, was in all Reſpects like that of *London Vitriol*; only ſeemed more gratefully *Acid*, and might, like it, be ſeparated into Spirit and Oil, corruptly ſo ſtiled.

Vitriol freed, as is before declared, from its *Earthy* and *Metallick* parts, by *Zink*, or other *Imperfect Minerals*, is much of the ſame Nature, and yields its Spirit in Sand, as this we have now mentioned; is alſo White, and more *Unctuous*; hath a Grain more like *Nitre* than *Vitriol*, as hath alſo the *Goſlar Vitriol*, which is White, and comparatively *Unctuous*, becauſe it hath little Metal, and leſs *Mineral Sulphur* than the common; whoſe *Metalline* Part detains the *Saline*, and will not diſmiſs it until long urged by a very intenſe degree of Heat. What remained in the *Retort* after this *Diſtillation*, was not red or purple, like the *Caput Mortuum* of the common *Vitriol*, but *White*, *Light*, and *Spongious*, like *burnt Alum*, and altogether as *Inſipid*; although, after it was ſome time expoſed to the *Air*, it received many ſtrange Impreſſions and Alterations.

I cannot but take notice here of the great Affinity that is between *Vitriol*, *Alum*, and *Mineral Sulphur*; the *Saline* Principle, which is in each of them by far the chief, both in Quantity and Energy, having one Nature and the ſame Properties. This will appear evident to thoſe who will compare with the common Spirit, or Oil of *Vitriol*, the *Acidity* of *Sulphur* afforded by Brimſtone inflamed under a Glaſs Bell; which being rectify'd, is not to be diſtinguiſh'd, by any ſenſible Property, from the well *Rectify'd Acidity*, or Oil of good *Vitriol*; and they may, I am confident, be ſafely ſubſtituted for each other, producing in Men and Metals the very ſame Effects, being in my Apprehenſion no leſs alike in their internal and ſecret, than in their *external* ſenſible Qualities.

n.104.p.66.

The Quantity indeed of *Acidity*, which is obtained in the ordinary Ways of Operation, is very ſmall, a Pound of Brimſtone not yielding above one Ounce or 10 Drams, the far greater Part being by the rapid Motion of the Flame ſublimed in the Form of *Flores*, which differ not from the common *Flowers*. I have been often aſſured by a Kinſman of that admirable Mechaniſt *Cornelius Drebbel*, that his Uncle did, by the means of conveniently ſhaped Veſſels, ordinarily obtain out of a Pound of good Brimſtone, 8, and in a very moiſt Seaſon, 10 Ounces of *Acidity*; and was confident, he could, by improving the Contrivance, recover the entire Weight of the *Sulphur*; the Moiſture of the Air acquired, making abundant recompence for the Avolation of what is *Incoagulable*. I have myſelf by the means of ſeveral *Menſtrua*, reduced common Brimſtone into the Form of an highly *Acid Corroſive* Liquor, and even Spirit of *Nitre*, or *Aqua Fortis* well rectified, being digeſted on the *Flowers* of *Brimſtone*, then diſtilled in Aſhes; this repeated 5 or 6 times, after the laſt *Cobobation* there will remain with the Flowers near their Weight of an *Acid Spirit*, like that made by a Bell; the Spirit of *Nitre* being ſcarcely changed from what it was before the Operation. And I ſuppoſe that being reiterated frequently, eſpecially if freſh Spirit be employed, the whole may be tranſmuted, abating ſome few Earthy and Metallick Particles, the Sulphureous being capable of a fluid Form, and are copious in Oil, in *Vitriol*, *Aqua Fortis*, and many other *Acid Menſtrua*, eſpecially if any imperfect Sulphureous Minerals were imployed with the other Ingredients in their Production.

I once made out of *Vitriol*, common *Salt*, and *Antimony*, a Liquor clear as any Fountain Water, yet the Smell intolerably Sulphureous, continuing ſo many Years: And true inflammable Sulphur may ſeveral ways be recovered out of Oil of *Vitriol*, or Sulphur, many times rectified and in appearance free from ſuch Mixture. We formerly mentioned its Separation by means of *Vinous Spirits*; alſo if mixt with Oil of *Turpentine*, and diſtilled, at the latter end ſtore of Brimſtone will ſublime: I ſuppoſe none will aſcribe this to the Vegetable Oil, which is only the means of its Separation, being an appropriate *Menſtruum* or Diſſolvent of ſulphureous Bodies. This recalls into my Mind what I have often obſerved, (and I ſuppoſe it always happens) in the Preparations of Balſam of *Sulphur* with the ſaid Oil of *Turpentine*:

pentine: After the Oil is ſatiated with *Sulphur*, it lets fall ſtore of fair *Chryſtals*; an evident Proof of its *Saline* Nature. For although theſe Chryſtals broken, within will appear full of *Sulphur*, their outward Parts or Superficies ſeem perfect Salt, by virtue whereof they are diſpoſed to *Chryſtallization*. I may indeed be objected, that *Chryſtallization* is not a ſufficient Proof of a *Saline* Nature, the *Eſſential Oils* (as they are called) of *Anniſeeds*, *Fennel-Seeds*, and of many other Subſtances being very prone to *Chryſtallize*. But moſt *Eſſential Oils* abound no leſs with Salt than common Sulphur, into which I have often converted them without additament or ſuſpicion of *Tranſmutation*.

The *Affinity*, I had almoſt ſaid *Identity* of the *Saline* Principle in Sulphur and Vitriol, further appears by the following Experiment. Take thin Plates of Copper, cement them carefully with common *Brimſtone*, *Stratum ſuper Stratum*, repeat the Operation 4 or 5 times with freſh Sulphur; moſt of the Copper will be converted into *Vitriol*, which diſſolved in Water, and moſt of that evaporated, yields very beautiful *Azure Chryſtals*. The ſame may be effected with Iron. Or, take the *Acidity* of *Sulphur* (corruptly call'd its Oil) moiſten therewith Filings of *Copper* or *Iron*; then free them by Fire or Air from ſuperfluous Moiſture, repeat this twice or thrice, and afterwards with common Water you may extract a fair *Vitriol*, which by the Chymiſts is called *Vitriolum Martis* or *Veneris*, according as the one or other Metal was imployed in order to its production: which ſame Metals being diſſolved in any *Acid Menſtrua*, and chryſtallized are converted into Vitriol. This is ſignified unto us by the common Name of Vitriol, vulgarly ſtiled *Cuperoſum*, *quaſi Cuprum Eroſum*; that being the Metal wherewith 'tis uſually aſſociated. Sulphur indeed is found mixt with moſt Metals and Minerals, Gold and Silver not being excepted, the moſt expert Mineraliſts in *Peru* accounting abundance of *Sulphur* an eſpecial ſign of rich *Ore*: And among the richeſt *Ore* of the Mountain of *Potoſi* are ſuch quantities of Brimſtone, that the Cavities and hollow Places are preſently filled with Flame, if a Candle touch or come near their Sides. Yet they do not ordinarily find *Vitriol* in Mines of Gold and Silver (unleſs mixed with other Metals) becauſe thoſe Bodies are ſomething too compact for the Sulphureous Spirit to diſſolve, aſſiſted with a ſmall degree of Heat; whereas all *Ores*, which touch on *Copper* or *Pyrites* abounding in *Sulphur*, do alſo afford *Vitriol*, Copper being an open Body, and more eaſily ſoluble than any other Metal; for it will preſently, though crude, diſſolve in, and give a deep Tincture to common *Volatile Urinous Spirits*: which cannot be affirmed of any other Metal, howſoever prepared; and therefore no wonder if it be not by the Steam of *Sulphur* ſo eaſily converted into *Vitriol*. And in the Bowels of the Earth it is, I do conjecture, moſtly produced after this manner; an *Acid Salino-Sulphureous* Steam (ſuch we have proved that of common *Sulphur* to be) inſinuating itſelf into a Vein of *Copper*, corrodes it, and uniting therewith, becomes *Vitriol*. So it doth by mixture with Iron and other Minerals; whence being waſhed with Water, it produces *Acidulæ* of divers kinds, according to the Nature of the Minerals wherewith the *Acid* is united. And that *Vitriol* and *Vitriolate Waters* are thus produced, is hereby confirmed, that many

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Ores and *Pyrites* being diſtilled *per Deſcenſum*, yield abundance of common *Sulphur:* The Remainder thereafter affords ſtore of *Vitriol*, although before Calcination it would have yielded none; the Fire enabling the *Sulphur* to corrode, and aſſociate with the *Metallick* Parts, that which is without mixture of *Metal*, or which hath thereof a very ſmall Proportion, continuing under the form of Brimſtone.

This to me ſeems the Reaſon, why *Vitriol* and Brimſtone are uſually found together; thoſe Minerals and Pyrites that abound with one, being uſually impregnated with the other: *Vitriol* not being a diſtinct Principle, but the genuine Offſpring of *Sulphur*, its material Cauſe; and Fire and Air, the efficient Cauſes of its Production.

I ſpeak of *Vitriol* generated in the Bowels of the Earth; for it may be, and is often, produced above Ground, by the *Aerial Salt* united with Mineral Subſtances copiouſly contained in *Marchaſites*, which it extricates, and coagulating therewith becomes a Vitriol. This *Aerial* Salt, which I have many ways procured, whilſt in the Air, is altogether unſpecificate, I mean freed from all Union with, or Determination by, any ſeminal Principles, (the *Primordials* of all *Species* in the Univerſe being in my Opinion *Spermatical*) but being once at the Command of the *Architectonick* Power of any Species, whatſoever that be, it is by it, with other Matter, determined in order to the Formation and Augmentation of the *Individuum*, and Propagation of the Species, and upon the Diſſolution of its Dwelling, returns whence it deſcended. Beſides this, there is alſo in the Air an *Acidity*, as is evident in *Iron* Bars, whoſe Superficies is thereby reſolved into a ſubtile *Crocus*; alſo in the Tarniſhing of *Poliſh'd* Metals, where Pit-Coal is much burnt, near unto and on the Sea, and where expoſed to certain Winds.

This *Acid Spirit*, with the Salt laſt mentioned, are Inſtruments by Nature imployed in almoſt every Operation; eſpecially the Salt, without which no perfect Animal can ſubſiſt a Minute, and all Vegetables deprived thereof, do immediately decay. It's well known that ſeveral Minerals and Pyrites, which are to the Taſte altogether inſipid and elixiviated, and would yield not a Grain of Salt, being expoſed to the Air are reſolved into a Powder, and afford ſome *Alum*, others Vitriol copiouſly. Sometimes the Minerals require previous Calcination, which opens and relaxes the Compages of the Bodies; ſo that the Air may have more eaſy ingreſs. And it is, I think, by moſt allowed, that after all the Salt is extracted out of Earth impregnated with *Vitriol*, *Alum* or *Nitre*, the ſaid Earth being expoſed a ſufficient time unto the Air, acquires freſh Supplies: which muſt be derived from the Air. And it is particularly remarkable in Vitriol and Alum, that their Spirit being put into a Commotion or Fermentation by either Heat or contrary natur'd Spirits, the Glaſſes which contain them being well cloſed, although large and ſtrong, will be cracked or broken in pieces; which ſeems to proceed from the Expanſion of ſome of thoſe prodigiouſly active ſpringy Particles, wherewith the Air abounds, which together with the *Aerial Salt* were arreſted by the vitriolifying Principle, and ſet at liberty by the tumultuating Liquor, the change of whoſe Contexture might occaſion their Diſmiſſion, the unbending of their Springs, and the Effects which thereupon enſue.

The Affinity between Vitriol and natural, not factitious, Alum, thus appears. Vitriol not only in *England*, but in ſeveral other Parts of the *World*, is ordinarily found in the ſame Vein, and ſometimes in the ſame Parcel, which yields the Alum: which may by ſeveral Methods be ſeparated from each other. The Mineral of Alum, if mature, *Elixiviated* yields its Salt preſently; if leſs mature, it requires previous Calcination; if very immature, it muſt not only be burnt, but long expoſed unto the Air.

The Cauſe whereof ſeems the very ſame with that we lately mentioned in our Account of the Production of Vitriol; the Alum, as that is, being produced by the *Sulphur's* acting on, corroding of, and coagulating with, ſome mineral Subſtance, which uſually partakes more of a *Terrene* and *Stony*, than *Metallick* Nature: although Metal is often found to be contained in the Alum-Stone or *Ore*. And that the *Sulphur* is the chief efficient and material Cauſe of its Production, appears from hence, that many Alum-Stones (as the Vitriolate) diſtill'd *per Deſcenſum*, yield good Brimſtone; and all Alum-Stone or *Ore*, during Calcination, emit a *Sulphureous* Steam. An inquiſitive Naturaliſt of my Acquaintance did gather from the very ſame Rock, and that within a few Inches of each other, Vitriol, Alum, and *Sulphur*, all of them excellent and perfect in their Kind. Indeed they are ſo nearly allied, that I can by ſome pretty Artifices (too long to be here deſcribed) convert *Alum* into *Vitriol*, or *Vitriol* into *Alum*, which ſhall be the *ſame*, to all Intents and Purpoſes (as we commonly ſpeak) with the *Natural*.

Alum diſtilled into an *Acid Spirit* with Copper or Iron, becomes good Vitriol; and Vitriol freed from its metallick Parts, becomes *Aluminous*; and diſtill'd, yields a Spirit ſcarcely to be diſtinguiſhed, not only by Taſte, but even by the nice and accurate Scrutiny, from that of Alum. And (which doth in ſome meaſure illuſtrate this *Affinity*) I have often obſerved rectified Oil of Vitriol and Spirit of Sulphur, to coagulate, and become ſolid tranſparent Concretions, exactly reſembling Alum chryſtallized, with which compared, I am confident, the moſt judicious Eye, without the aſſiſtance of the Palate, would find little difference.

The *Salt* in *Brimſtone* is thus derived. *Brimſtone* conſiſts of *Mineral Sulphur* and an *Acid Salt*, which being united, it is no difficult matter to conceive how it ſhould become *Volatile*, if we reflect on *Cinnabar* and *Sublimate*; in one, *Mercury* is ſo diſguiſed by a little *Sulphur*, that it ſeems a *Mineral* Subſtance of another nature, and abating the Colour, not unlike *Antimony*; in the other, Salts very acid and fixt are rendered ſufficiently volatile. Now whence the Brimſtone ſhould derive its ſulphureous Particles, will appear very obvious to them, who have obſerved how much the Bowels of the *Earth* abound with *Bituminous* Subſtances. What elſe feed all the *Subterraneous Fires*? What an immenſe Quantity thereof is lodged in the *Earth*, will be atteſted by our large and numerous *Coal-Mines*, and by thoſe Eruptions of *Bituminous* Subſtances in many Quarters of the World; among which that call'd *Naptha*, is ſo purely ſulphureous, ſo free from Mixture with any other Materials, that upon the very Approach of Fire or Flame, it is immediately inflamed, and ſcarcely to be extinguiſhed until wholly conſumed. As for the ſaline Principle of *Sulphur*, I conclude it to be common *Salt*, which, together with the *Aerial Salt* before-mentioned, is the Foundation of all *Saline* Subſtances in the Univerſe. And I aſſure you, I can with common Salt make both *Vitriol* and *Alum*, hardly diſtinguiſhable from the natural.

The Effloreſcence of certain Mineral Glebes, by Dr. Liſter, *n.* 110. *p.* 221.

XCI. I kept by me certain big Pieces of *Crude Alum Mines*, ſuch as it was taken out of the Rock; I had alſo in the ſame Cabinet like Pieces of the ordinary *Fire-Stone*, or *Marchaſite* of the Coal-Pits, which here we call *Braſs Lumps*.

In proceſs of Time, both the Glebes ſhot forth *Tufts* of long and ſlender Fibres or Threads; ſome of them half an Inch long, bended and curled like Hairs in both theſe Glebes: Theſe *Tufts* were in ſome meaſure tranſparent and chryſtalline. Theſe *Tufts* did as often repullulate, as they were ſtruck and wiped clean off.

The *Aluminous Fibres* were of a *Taſte* very *Alumy*, and pleaſantly pungent: The *Vitriolick*, *Stiptique* and *Odious*. Again, the *Alum* ones, being diſſolved in fair Water, raiſed a ſmall *Ebullition*: Whereas the *Vitriolick Fibres* diſſolved quietly. The *Alum Fibres* were generally ſmaller, and more opaque, Snow-like. The *Vitriolick* larger, many Fibres equalling a Horſe-Hair in thickneſs, and more *Chryſtalline*. The Water wherein the *Alum Fibres* were diſſolved, did give no red Tincture with Gall, not by all the Means I could deviſe to aſſiſt them: The *Vitriolick* did immediately give a *Purple Tincture* with *Gall*.

Having laid Pieces of the ſame *Marchaſite* in a Cellar, they were in a few Months covered over with green *Copperas*, which was theſe Fibres ſhot and again diſſolved, by the moiſt Air, clodder'd and run together. Expoſing other Pieces of the ſame *Vitriolick* Glebe in my Window, where the Sun came, they were covered over with a white farinaceous Matter; that is, with theſe *Fibres* calcined by the Rays of the Sun and warm Air, beating upon them.

I take theſe fibrous and thread-like Shootings of *Alum* and *Vitriol* to be moſt genuine and natural, and their angular Shootings, after Solution into *Cubes* and *Rhombodies*, to be forced and accidental; *Salts* of very different Natures, as well Vegetable as Foſſile, by a like Proceſs in chryſtallizing of them, being obſerved to ſhoot into like Figures.

Amianthus; *By* . . *n.* 72. *p.* 2167.

XCII. 1. Signior *Marco Antonio Caſtagna*, Superintendant of ſome Mines in *Italy*, hath lighted, in one of them, upon a great Quantity of that lanuginous Stone called *Amianthus*, which he knows ſo to prepare as to render it like either to a very white *Skin*, or to a very white Paper; both which reſiſts the moſt violent Fire. The Skin was covered with kindled Coals, whence it took flame; but being taken out, after it had been left there a while, the fiery Colour preſently diſappeared, and it became cold and white again as before; the Fire it ſeems paſſing only through, without waſting or altering any thing of it: whereas ſome of the hardeſt and ſolideſt Metals, as *Iron* and *Copper*, reduced to very thin Plates, and kept as long in the Fire as this Subſtance was, would caſt Scales. Again, this Skin being made as thin as Paper, doth not only yield that ancient and ſo much admired *Amianthus*; but is alſo perfecter than that which comes from *Cyprus*, and not inferior to that which ſometimes, though but ſeldom, comes out of *China*. This Paper was alſo tried in the Fire, and there it remained likewiſe without any viſible detriment, or without the leaſt change of its firſt whiteneſs, fineneſs or ſoftneſs. Of the ſame Matter this Artiſt hath wrought a Wick, never to be conſumed as long as 'tis fed, nor altering its Quality after the Aliment is waſted away.

By Mr. Edw. Lloyd, *n.* 176. *p.* 823. 2. The *Lapis Amianthus*, or *Linum Foſſile Aſbeſtinum*, is found in no ſmall Quantity in *Llyan Fairyng Hornwy* in the Northern Part of *Angleſey*, where it runs in Veins through a thick Stone, in hardneſs and colour not unlike Flint. Theſe Veins are generally about $\frac{1}{4}$ of an Inch deep, which is the length of the *Amianthus*, and is ſeldom longer, but often ſhorter. It is compoſed of a lanuginous Matter, exactly reſembling that of pappous Plants; but ſo cloſely compact, that till you draw a Pin, or any ſuch ſharp thing, croſs the Grain of it, it appears only a ſhining Stone, there being not the leaſt Filament of *Lint* to be perceived in it. In its natural Form, ſome of it looks whitiſh, and ſome ſtraw-coloured, but all ſhining; but if pounded in a Mortar, the Brightneſs diſappears, and the whole becomes whitiſh. Note, that above and beneath the Veins there is a very thin *Septum* of terrene Matter, betwixt the *Amianthus* and the Stone whereto it adheres. I put a ſmall Quantity of the Lint in the Fire, which grew red hot; but tho' it remained there $\frac{1}{4}$ of an Hour, I could not perceive that it was any thing conſumed. I twiſted alſo ſome of it in the Form of a Wick, and dipping it in Oil, it gave as good a Flame as other Wicks, till the Oil was conſumed, the *Wick* remaining of the ſame Proportion as at firſt. Being ſatisfied it was incombuſtible, I pounded ſome Quantity of it in a Stone Mortar, till it became a downy Subſtance: then I ſifted it thro' a fine Searce, by which means the terrene Parts (being reduced to a Powder) came thro' the Searce, the *Linum* remaining. I then brought it to a *Paper-Mill*, and putting it in Water in a Veſſel juſt capacious enough to make Paper with ſuch a Quantity, I ſtirred it pretty much, and deſired the Workmen to proceed with it in their uſual Method of making *Paper*, with their *Writing-Paper Mould*, only to ſtir it about ever before they put their *Mould* in, conſidering it as a far more ponderous Subſtance than that they uſed; and that conſequently if not immediately taken up after it was agitated, it would ſubſide. Paper thus made of it, proved but very coarſe, and too apt to tear: But this being the firſt Trial, I have ſome reaſon to believe it may be much improved.

Incombuſtible Cloth, by Mr. Nic. Waite, *n.* 178. *p.* 1049. XCIII. I here ſend you the Account of the *incombuſtible Linnen Cloth*, which I received from one *Conco*, a natural *Chineſe*, Reſident in the City of *Batavia* in the North-Eaſt Parts of *India*, who by means of *Kaayarear Sukradana* (likewiſe a *Chineſe*, and formerly chief Cuſtomer to the old *Sultan* of *Bantam*) did after ſeveral Years Diligence, procure from a great *Mandarin* in *Lanquin*, (a Province of *China*) near ¾ of a *Yard* of the ſaid Cloth; and declared that he was credibly informed, that the Princes of *Tartary*, and others adjoining to them, did uſe it in burning their *Dead*; and that it was ſaid and believed by them, to be made of the under part of the Root of a Tree growing in the Province of *Sutan*, and was ſuppoſed, in like manner, to be made of the *Todda Trees* in *India*; and that of the upper part of the ſaid Root near the Surface of the Ground, was made a finer ſort, which in 3 or 4 times burning, I have ſeen diminiſh almoſt half. They report alſo, that out of the ſaid *Tree* there diſtils a Liquor, which not conſuming, is uſed with a Wick made of the ſame Material with the Cloth, to burn in their *Temples* to Poſterity.

2. A Handkerchief, or Pattern of this *Incombuſtible Linnen*, which was *By . . . ib.* ſhewn the *Royal Society*, was a Foot long, and juſt half a Foot broad. *p. 1050.*

There were two Proofs of its reſiſting Fire, given at *London*, one before ſome of the Members of the *Royal Society* privately, *Aug.* 20, 1684, when *Oil* was permitted to be poured on it whilſt red-hot, to enforce the Violence of the Fire. Before it was put into the Fire this firſt Trial, it weighed one Ounce, ſix Drams, ſixteen Grains, and loſt in the burning 2 Drams, 5 Grains.

The ſecond Experiment of it was publick before the *Society*, *November* 12 following, when it weighed (as appears by the Journal of the *Society*) before it was put into the Fire, 1 Ounce, 3 Drams, 18 Grains. Being put into a clear Charcoal Fire, it was permitted to continue red hot in it for ſeveral Minutes: When taken out, tho' red hot, it did not conſume a piece of white Paper on which it was laid. It was preſently cool, and upon weighing it again, was found to have loſt 1 Dram, 6 Grains.

Decemb. 3. Mr. *Arthur Baily*, one of the Fellows of the *Royal Society*, preſented them with a piece of this Linnen in the Name of Mr. *Waite*. At the ſame time, the ſame Mr. *Baily* preſented Dr. *Plot* with another Piece of it, which being brought to *Oxford*, the Experiment was again repeated on it, *Decemb.* 16. it being put into a ſtrong Charcoal Fire, in the *Natural Hiſtory School*, in a full Meeting of the *Philoſophical Society* of that *Univerſity*, where after it had continued red hot for ſome conſiderable time, it was taken forth again little altered when cold, ſaving that it ſeemed a little whiter and cleaner than before.

3. This kind of *Linnen Cloth* was eſteemed by the Ancients, though then *By Dr. Rob.* more common, and perhaps better known, than it is yet amongſt us, equally *Plot, ib. p.* precious with the beſt of *Pearls*. *1051.*

Nor is it now of mean Value even in the Country where made, a *China Covet*, (*i. e.* a Piece 23 Inches and ¾ long) being worth 80 *Tale*, *i. e.* 36 *l.* 13 *s.* and 4 *d.*

The *Reality* of ſuch a Being has been doubted, or denied by very good Authors: Who though they owned ſuch a *Mineral* as *Amianthus*, out of the woolly Part whereof, this ſort of Linnen was always anciently ſaid to be made, yet queſtioned the Poſſibility of its having been actually done. But *Pliny* ſays expreſly (and I dare believe him in any thing he ſpeaks of his own Knowledge) that he himſelf had ſeen *Napkins* thereof, which being taken foul from the Board of a great Feaſt, were caſt into the Fire, by which means they were better ſcoured, and looked fairer and cleaner than if they had been waſhed in Water.

And beſides the Teſtimony of ſeveral curious Perſons in all Ages, we have now ſeen a Piece of this Linnen paſs the fiery Trial both at *London* and *Oxford*.

This *lanuginous Mineral* is called from its ſtrange Qualities, ſometimes *Amianthus*, quod in Ignem injectus non μιαίνεται; the Fire being ſo far from defiling it, that it rather gives it a Luſtre.

2. It is called *Aſbeſtos*: And,

3. *Salamandra*, in *Engliſh*, *Salamander's Wool*: I ſuppoſe from the *Thryallides*, or *Candle-Wicks*, ſaid to be anciently made of it, which being put into *Lamps* of *inconſumable Oil*, would never waſte or go out; which I take to be the true reaſon of the Impoſition of theſe Names upon it, whether there ever were any ſuch Lamps or no.

4. From a *pungent* Quality, *Agricola* ſays, it has on the Tongue without *Aſtringency*, it is called *Alumen*, having the diſtinguiſhing Epithet *Plumeum* added to it, taken from its downy Filaments, to diſcriminate it from all the reſt of the *Alums*.

5. From the light gray Colour of its lanuginous Parts, it is called by ſome *Polia*, by others *Corſoides*; and from its likeneſs to the hoary Fibres of ſome ſort of *Mat-Weed*, *Spartapolia*.

6. From the Capacity it has of being ſpun into Thread, it is alſo called *Linum*, with ſome diſtinguiſhing Epithet taken either from its Quality, ſuch as *Aſbeſtinum*, or *Vivum*; or from the Place where found in general or particular: It being called in general *Linum Foſſile*; in *Engliſh*, *Earth-Flax*; and in particular, *Linum Indicum*, *Creticum*, *Cypricum*, & *Carpaſium*, or *Caryſtium*. But beſides the Places that have given theſe Epithets to the Thread made of it, it is alſo found in *Tartary*, at *Namur* in the *Low-Countries*, at *Eiſfield* in *Thuringia*; among the *Mines* in the old *Noricum*; ſomewhere in *Egypt*; and in the Mountains of *Arcadia*; alſo at *Puteoli*, and lately in ſome *Mines* in *Italy*; and it has been yet latelier met with in a ſmall Iſland belonging to *William Robinſon*, Eſq; called *Ynis Molroniad*, i. e. the Iſland of *Sea-Calves*, in the Pariſh of *Llan-Fairing Hornwy* in *Angleſea* in *Wales*.

It is commonly by the *Lithographers* reckoned among Stones, but I rather ſhould judge it a *Terra Lapidoſa*, or middle Subſtance between a Stone and an Earth. But whether the one or the other, it is made of a Mixture (I gueſs) of ſome Salt or other, a pure Earth without Sulphur, coagulated in the Winter, and hardened to Perfection by the Heats in Summer; which Salt *Johannes Heſſus* proves by a very cogent Argument to be *Alumen Liquidum*, *quidam*, deſcribing it as *Mathiolus* alſo does, to be of a whitiſh lacteous Subſtance, ſomewhat inclining to Yellow, that ſweats out of the Earth, and ſmells like rotten *Cheeſe*; whereof having gathered a Quantity at *Puteoli*, together with the other Species of *Alum*, and kept it a while by him, when he came to look on it again, he found it to have loſt the Smell, and a great Part of it changed into *Alumen plumeum*; the *ſaline* Part, I ſuppoſe, ſhooting into Threads, and the pure Earth uniting them, as found in the Places whereever generated; whether ſweating from the Earth, as *Pliny* and *Mathiolus* would have it, or percolated through *Rocks*, as we find it in *Wales*, the Veins of it there running through a Rock of Stone, in Hardneſs and Colour not unlike Flint.

And yet ſeems to be made of ſuch an *Alum*, as that of *John Heſſus* at *Puteoli* was, ſome of it being Straw-coloured, as if it ſtill retained the Yellowneſs that his liquid *Bitumen* was ſaid to have; which is a Colour not given to it by any Author, moſt of it being ſaid to be White, or cinerous; ſome of it Red, and ſome of an Iron-Colour, as *Agricola* tells us; and I have ſome of the *Cyprian* by me, ſent from *Aleppo*, by Dr. *Robert Huntington*; whereof ſome is of a light Blue, or Pearl-Colour, and ſome of it has a caſt of Sea-Green.

But however the whole Mineral Subſtances found at ſeveral Places may differ in Colour, yet I do not find but the woolly Part of them all ſeems to be much the ſame, *viz.* of a White Silver-Colour, the Threads very fine and ſlender, yet very ponderous; the ſmalleſt Particles of them thoroughly wet, ſinking in Water, as I alſo found a very ſlender Thrum of the *incumbuſtible Linnen* given me by Mr. *Baily*, which Mr. *Waite* brought from *India*; would alſo do; which renders it very probable that it is not a Vegetable, but a Mineral Subſtance, notwithſtanding the Informations of *Conco* and *Keayarear Sukradana*, mentioned in Mr. *Waite*'s Letter; I ſay, render it probable there being ſeveral Woods, ſuch as *Box*, *Red-Wood*, *Perſian Wood*, &c. that will ſink in Water.

Marcus Paulus Venetus acquaints us, that it is found in *Tartary* in a certain Mountain in the Province of *Chinchinthalus*; and made into Cloth, as he was informed by one *Curſicar*, a *Turk*, who was Superintendant of the Mines in that Country, after this manner: The lanuginous Mineral of *Amianthus*, being firſt dried in the Sun, is next pounded in a braſs Mortar, and the earthy Part ſeparated from the woolly, which is afterwards waſhed from all Filth whatever that may ſtick to it; and ſo, being thus purged, is ſpun into Thread like other Wool, and after wove into Cloth; which if foul or ſpotted, they cleanſe, he ſays, by throwing it into the Fire for an Hour's time, whence it will come forth unhurt, as white as Snow. Which very Method (as *Strabo* deſcribes it) ſeems alſo to have been uſed in ordering the *Cretan Amianthus*; only with this Addition, that after it was pounded, and the earthy Part ſhook from the woolly, he ſays, it was combed, and ſo does *Agricola*, which argues there was ſome of a greater Length than any I have yet ſeen. *De Region. Orientalibus.*

Of this Linnen, as *Pliny* informs us, Shrouds were antiently uſed, at the Royal Obſequies, to wrap up the Corps in, ſo as that the Aſhes of their Bodies might be preſerved diſtinct from thoſe of the Wood, which made the Funeral Pile: And the Princes of *Tartary*, as *Keayarear Sukradana* was credibly informed (and I have it well confirm'd from other Hands) do uſe ſuch at this Day for burning their Dead. It muſt be acknowledged, it does diminiſh every time it undergoes the Violence of the Fire; yet this hinders not, but it may, and will, do that Service divers times, before it be render'd altogether uſeleſs. Some of the Antients are ſaid to have made themſelves Cloths of it, particularly the *Brachmans* amongſt the *Indians*. The Wicks for the perpetual Lamps of the Antients were alſo made of this Subſtance; and we are told, that *Septalla*, Canon of *Milan*, had Thread, Robes, Net-works, and Paper of it. *Marco Antonio Caſtagna*, who lately found this Mineral ſomewhere in *Italy*, knows how to prepare and render it tractable and ſoft; which he can thicken and make thin to what Degree he pleaſeth, and maketh it thereby, like either a very white Skin, or a very white Paper. We have alſo made Paper of our *Welſh Amianthus* lately here at *Oxford*, which will both bear Fire and Ink well enough, the Ink only turning red by the Violence of the Fire.

To ſhew the Reaſon whence it is that this Subſtance ſhould be ſo ſtrangely privileged by Nature, we conſider, that the Qualities and Power of the Fire, according to *Ariſtotle*, are διακρίνειν τὰ μὴ ὁμόφυλα, συγκρίνειν δὲ τὰ ὁμόφυλα, to ſeparate things of a different, and unite thoſe of a like Nature. Hence it is, that the Subjects moſt apt to take Fire, and be diſſolved by it, we find to be ſuch heterogeneous Bodies, in whoſe Pores the moſt ſulphurous bituminous and aqueous Particles are lodged; which being ſeized by Fire, are quickly put into Motion, dilated and ſeparated; and being thus made capable of flying away, are at laſt conſumed, and diſſolve the Frame of thoſe Bodies whoſe Parts before were united by them. When theſe are fled and gone, the Fire naturally goes out, as having nothing now left to work upon, nothing remaining but the Salts and Earth in the Form of Aſhes, which in all ſorts of Compounds are the things that reſiſt this Element moſt, and will remain after the moſt exalted Operation it can be forced to. Nor do the Salts only of mixt Bodies thus baffle the Force of Fire; but the ſimple ones much more, as being more *homogeneous*, as we ſee in the Decrepitation of common Salt, and Exſiccation of Vitriol, which, when the aqueous Parts are once evaporated, are now a pure ſimple homogeneous Body, no more ſenſible of the Fire, the Decrepitation ceaſing, and nothing remaining that can be dilated any further to break the Corns of Salt. Now whatever the Fire cannot dilate, it cannot ſeparate, nor conſequently deſtroy, or carry any thing from it but what is heterogeneous, and accidentally adhering to the outſide of it; which is perfectly the Caſe of our incombuſtible Linnen, whoſe Threads being altogether homogeneous, and nothing elſe but the pure *Striæ* of liquid Alum, as was ſhewn above, holding nothing of Sulphur, Bitumen or Water, or any thing that is different or heterogeneous to it ſelf, that can be dilated or ſeparated, it is in no poſſibility of being liable to the Fire; which may indeed paſs thro' it, as we ſee it does when it is made red hot, but can carry nothing from it, but ſuch accidental Filth as has been put upon it, or accrued by uſing.

Lapis Calaminaris, *By Mr.* Giles Pooley, *n.* 198. *p.* 67[illegible]

XCIV. The *Lapis Calaminaris*, or *Calamine*, which is digged and prepared near *Wrington* in *Somerſetſhire*, is found ſometimes in Meadows, ſometimes in arable, ſometimes in paſture, and as I have obſerved, moſt commonly in barren and rocky Ground. The Waters thereabouts are much of the ſame Colour, Taſte, Clearneſs, and Wholeſomneſs with other Water. The Graſs upon the Ground, and the Leaves of the Trees, are as freſh where Calamine lies as in any other Place. But this I obſerve, that the Groovers always dig for it upon or near Hills; for they expect none in thoſe Grounds which have no Communication with Hills.

To find out a Vein, they dig a Trench till they come to the Rocks, where they expect it lies; which Trench they generally dig from the North to South, or near upon that Point, the Courſes uſually lying from Eaſt to Weſt, or at 6 a Clock, as their Term is; but ſometimes the Courſes, Seams, or Rakes, as they call them, lie at 9 a Clock, and ſometimes are perpendicular, which they call the high time of the Day, or 12 a Clock: and theſe Courſes they eſteem the beſt. Theſe Seams or Courſes run between the Rocks generally wider than thoſe of Lead-Ore, unleſs they are incloſed in very hard Cliſts, and then they are narrow as the Veins of Lead. The Colour of the Earth where the Calamine lies, is generally a yellow Grit, but ſometimes black; for all Countries, as they term their underground Works, are not alike.

The Calamine itſelf is of ſeveral Colours, ſome white, ſome reddiſh, ſome greyiſh, ſome blackiſh, which is counted the beſt; and when this is broken it is of ſeveral Colours.

In working for it below in the Countries, they uſe the ſame Way and Inſtruments, as they do in Lead Mines, and ſometimes they light upon a good Quantity of Lead, but always find ſome Eyes of Lead among the Calamine; tho' I think, in Lead Mines, they do not always find Calamine. In landing of the Calamine, ſome Pieces are bigger than others, and mixt with a gritty Earth. I have been inform'd, that they have found one entire Piece of 8 or 10 Tun, which by reaſon of its bigneſs was forced to be broken in the Groove before it could be landed. But generally it riſeth in ſmall Particles; ſome about the bigneſs of a Nut they call a ſmall Calamine. In antient Works, Damps and Stenches ſometimes ariſe, but never in new Works.

When they have landed a good Quantity of the Calamine, they waſh, clean, or buddle it, as their Term is, which they perform after this manner. They encloſe a ſmall Piece of Ground with Boards or Turfs, through which a clear Stream of Water runs; within this Encloſure they ſhovel and often turn their Calamine, and the impure and earthy Parts the running Water carries away, and leaves the Lead and the Calamine, and the other heavier ſtony and ſparry Parts behind. When they have thus waſhed the Calamine, as clean as they can, having raked up the bigger Pieces both of the *Lead* and *Calamine*, they put the ſmaller Parts into Sieves, made of ſtrong Wire at the bottom: And theſe they often dip and ſhake up and down in a great Tub of Water, whereby the Parts of the *Lead* which are mixt amongſt the *Calamine* ſink to the bottom of the Sieves, the *Calamine* remains in the middle, and the other ſparry and thraſhy Parts riſe up to the top; which they ſkim off and throw away; then they take off the *Calamine*, and after that the *Lead*. When they have thus cleanſed the *Calamine*, they are forced to ſpread it abroad, and ſo pick out with their Hands the Traſh and Stones that remain. But all of it does not require ſo much Trouble; for ſome riſeth big enough out of the Works to be cleanſed and picked fit for the calcining Oven without all this Charge and Pains: And I have ſeen ſeveral Loads of this great *Calamine*, which had no Mixture of Earth or Traſh in it.

Their *Calamine* being thus prepared, they carry it to the Oven, which, at leaſt that which I ſaw, is much bigger than any Baker's Oven, and made much in the ſame Faſhion: Only they caſt in their Coals into a Hearth made on one ſide of the Oven, which is divided from the Oven itſelf by a Hem or Partition made open at the Top, whereby the Flame of the Fire paſſeth over, and ſo heats and bakes the *Calamine*. They let it lie in the Oven for the ſpace of four or five Hours, (the Fire burning all the while) according to the Strength of the *Calamine*, ſome being much ſtronger than other, and ſo requiring longer time; and while it continues in the Oven, they turn it ſeveral times with long Iron Coal-rakes; when it is ſufficiently burned, baked, and dried, they beat it to a Powder with long Iron Hammers, like Mallets, upon a thick Plank, picking out what Stones they find amongſt it; ſo that at laſt the *Calamine* is reduced to Duſt, and then it is fit for the Merchant.

I have been credibly informed that the Duſt of *Calamine* conduces much to the curing of ſore Eyes of Men: And that it is frequently made uſe of, for the taking off Films from the Eyes of Horſes and other Beaſts.

To vitrify Antimony *with* Cawk; *By Dr.* Mar. Liſter, *n.* 110, *p.* 225.

XCV. 1. Take of *Antimony* one Pound, flux it clear; have one Ounce, or two, of the *Cawk-Stone* (by and by to be deſcribed) in a Lump red hot in readineſs. Put it into the Crucible to the *Antimony*; continue the Flux a few Minutes: Caſt it into a clean and not greaſed Mortar, decanting the melted Liquor from the *Cawk*.

This Proceſs gives us above 15 Ounces of *Vitrum* of *Antimony*, like poliſhed *Steel*, and as bright as the moſt refined *Quickſilver*. The *Cawk* ſeems not to be diminiſhed in its Weight, but rather increaſed; nor will it be brought to incorporate with the *Antimony*, though fluxed in a ſtrong Blaſt.

Vid. Sup. §. XLVI.

This *Cawk-Stone* is a very odd Mineral, much a-kin to the white milky mineral Juices of the *Lead-Mines*, which vitrifies in like manner. Beſides theſe I could never light upon any one mineral Subſtance, which had any ſuch Effect upon *Antimony*.

Cawk is a ponderous white Stone, found in the *Lead-Mines*; it will draw a white Line like *Chalk* or the *Gallactites*; but it is more fine, and hath a ſmooth and ſhining Grain, *Sparr*-like, yet not at all tranſparent.

2. I try'd that a Boar, to whom I had given an Ounce of *crude Antimony* at a time putting him into the Sty, would be fat in a Fortnight before another, having no *Antimony*, upon the like Feeding. *Antimony* will recover a Pig of the *Meaſles*; by which it appears to be a great Purifier of the Blood. I knew a Horſe that was very lean and ſcabbed, and could not be fatted by any Keeping, to whom *Antimony* was given for two Months together every Morning, and that upon the ſame Keeping he became exceeding fat. One of my own Horſes having had the *Faſhions*, and being cured, and notwithſtanding extream running Legs; ſo that after he had paſſed the Courſe of Farriers twice, to be cured, it was not done; but upon my giving him *Antimony* one Week, he was preſentlly healed.

The Virtue of Antimony; By — *n.* 39. *p.* 774.

The manner of uſing it is this: Take one ʒ of *Crude Antimony* powdered for one Horſe, and when you give him his Oats in a Morning, ſhake it out amongſt his Oats; or make it in Balls.

XCVI. A ſmall Vial filled with ordinary white Sand, and containing only ℔ i. gr. xi. being filled with *Virginia* Sand was found to contain ʒ ii. ℈ ii. gr. 1.

A black ſhining Sand from Virginia; Examined by Dr. All. Moulen, *n.* 197. *p.* 624.

This *Sand* did apply to the *Magnet* both before and after *Calcination*; but the latter did apply better to it than the former.

A Parcel of this *Sand* mixed and calcined with powdered Charcoal, and kept in a melting Furnace for about an Hour, yielded no *Regulus*, but applied more vigorouſly to the *Load-ſtone* than either of the former.

I fluxed a Parcel of this *Sand* with *fixed Nitre*, in a melting Furnace, for above an Hour, but could obtain no *Regulus*, nor any Subſtance that would apply to the *Magnet*, except a thin Cruſt that ſtuck firmly to a Piece of Charcoal that dropt into the Crucible when the Matter was in Fuſion.

I fluxed it alſo with *Salt-Petre* and powdered *Charcoal*, dropping Pieces of *Charcoal* afterwards into the Crucible. It continued about an Hour in the melting Furnace in Fuſion, and that without producing a *Regulus*, or a Subſtance that would apply to the *Magnet*, excepting only what ſtuck to the *Charcoal*, as in the former Experiment.

I fluxed another Parcel of it with *Salt-Petre* and *Flowers* of *Brimſtone*, without being able to procure any *Regulus*.

I poured good *Spirit* of *Salt* on a Parcel of this *Sand*, but could obſerve no *Luctation* thereby produced.

I poured *Spirit* of *Nitre*, both ſtrong and weakned with Water, on Parcels of the ſame *Sand*, without being able to diſcover any Conflict.

I poured ſingle *Aqua Fortis* upon another Parcel of it, without being able to perceive any *Ebullition* worth noting.

I poured double *Aqua Fortis* upon another Parcel of it, which, for ought I could diſcover, had no more Effect on it than the former.

I pour'd alſo ſome *Aqua Regia* on a Parcel of it, without diſcovering any ſenſible Effect. I pour'd good Oil of *Vitriol* upon another Parcel of this Sand, but ſeeing no Bubbles thereby produced, I weakened the Oil with Water, but without any ſenſible Effect.

I repeated all the former Experiments with the *Menſtruums* upon this Sand after Calcination *per ſe* in a Crucible, but could ſcarce obſerve a Bubble produced by any of them.

I pour'd ſome of each of the Liquors upon Parcels of the Powder of this Sand calcin'd, without any Succeſs.

Note, That I made theſe Experiments both in the Cold, and upon a Sand-Furnace. So that to me there ſeems to be but little wanting to diſcover any Metal known to us, if it contained any ſuch: for there is no Metal nor Ore that ſome of theſe *Menſtruums* will not work on.

I powder'd a Fragment of a Load-ſtone, and pour'd ſome of theſe *Menſtruums* upon it, without being able to find that they in the leaſt prey'd upon it, any more than they did upon the Sand.

I pour'd ſome of the aforementioned *Menſtruums* upon ordinary Sand taken out of a Sand-Furnace, where it muſt have ſuffer'd ſome Calcination; but could find no more Bubbles produc'd thereby, than what might rationally be ſuppoſed to be produc'd from Lime, and other Dirt mixt with the Sand.

A black Sand *from* Italy; *By Mr.* Butterfield, *n.* 244. *p.* 336.

XCVII. The black Sand, which in *Italy* they uſe inſtead of Duſt to their Letters, is found ſix Miles from *Genes* near *St. Pierre d'Araine* on the Sea-ſhore. It hath the Properties of the Load-ſtone, and I do believe that it is Load-ſtone, or Powder of Load-ſtone, for it followeth the Load-ſtone; it ſticketh to a Knife that is touched with the Load-ſtone; it draweth a magnetick Needle; it doth not ferment with *Aqua Fortis*, as Iron Duſt doth; it doth not ruſt with any Acid that can be put to it; it doth not ſparkle in the Flame of a Candle, as Steel-Duſt doth, when it is thrown into the Flame. It is commonly found on the Sea-ſhore after great Storms.

To make Metal *run* ſmooth *and* cloſe; *By* .. *at* Frankfort *on the* Main, *n.* 94. *p.* 6040.

XCVIII. A certain Powder lately invented in *Germany*, maketh Metal ſo cloſe and ſmooth, that it leaves not the leaſt Pit in the Piece: a Gun ſo caſt needs no boring, and one third of the Metal may be ſpared. Such Guns remain clean and neat a long while. *July* 9, 1672, there was caſt a Demi-Cannon, weighing 34 Hundred, which was tried with a Bullet of 34 lb. and the firſt time 12 lb. of ſtrong Powder, the ſecond time as much, the third time 15 lb. and the fourth time 24 lb. all which it endured very well. With a ſmall Petard, of 2 lb. of this Metal, I broke in pieces a Beam of a *Rhine* Foot ſquare, the Petard remaining entire and perfect.

This Powder is not only eaſy to make, but alſo of ſmall Expence.

Iron Works in Gloceſter-ſhire; By Mr. Hen. Powle, n. 137. p. 931.

XCIX. 1. The Foreſt of *Dean* (lying betwixt the *Wye* and *Severn*) conſiſts generally of a ſtiff Clay. The Country is full of Hills, but they are no where high: Betwixt them run great Store of little Springs of a more browniſh Colour than ordinary Waters, and often leave in their Paſſage Tinctures of Ruſt. The Ground is naturally inclin'd to Wood, eſpecially Haſle and Oak; but 'tis now almoſt devoured by the Increaſe of the Iron-works. Upon the Surface of the Earth, in many Places, lie an abundance of rough Stones, ſome of them of a vaſt Bulk; but where they ſink their Mines, they rather meet with Veins of ſcaly Stone, than hard and ſolid Rocks. Within the Foreſt they find great plenty of Coal and Iron-Ore; and in ſome Places red and yellow Oker.

The Iron-Ore is found in great abundance in moſt Parts of the Foreſt, differing both in Colour, Weight, and Goodneſs. The beſt, which they call their Bruſh-Ore, is of a bluiſh Colour, very ponderous and full of little ſhining Specks like Grains of Silver. This affords the greateſt quantity of Iron: but being melted alone produceth a Metal very ſhort and brittle. To remedy this Inconveniency, they make uſe of Cinder, which is found in great Quantities thro' all Parts of the Country, where any former Works have ſtood; for in former Times, their Bellows being mov'd only by the Strength of Men, their Fires were much leſs intenſe than in the Furnaces they now employ: So that they melted down only the principal Part of the Ore, and rejected the reſt as uſeleſs. This is called Cinder, and being mingled with the Ore in a due Quantity, gives it that excellent Temper of Toughneſs, for which this Iron is preferr'd before any that is brought from foreign Parts.

The Ore is firſt calcined in Kilns, much after the Faſhion of ordinary Lime Kilns, which they fill up to the top with Coal and Ore, *Stratum ſuper Stratum*: Then putting Fire to the bottom, they let it burn till the Coal be waſted. This is done without Fuſion of the Metal, and ſerves to conſume the more droſſy Parts of the Ore, and to make it friable. From hence they carry it to their Furnaces, which are built of Brick or Stone, about 24 Foot ſquare on the Outſide, and near 30 Foot in height: Within not above eight or ten Foot over in the middle, the top and bottom having a narrower Compaſs, much like the Shape of an Egg. Behind the Furnace are placed two huge Pair of Bellows, whoſe Noſes meet at a little Hole near the bottom. Theſe are compreſſed together by certain Buttons, placed on the Axis of a very large overſhot Wheel.

The Furnaces are at firſt filled with Ore and Cinder intermixt with Fuel, which in theſe Works is always of Charcoal; laying them hollow at the bottom, that they may more eaſily take fire: But after they are once kindled, the Materials run together in a hard Cake or Lump which is ſuſtained by the Faſhion of the Furnace, and thro' this the Metal, as it melts, trickles down into the Receivers, where there is a Paſſage open, by which they take away the Scum and Droſs. Before this lies a great Bed of Sand, wherein they make Furrows of what Faſhion they pleaſe; into theſe they let in their Metal, which is made ſo very fluid by the Violence of the Fire, that it continues

tinues boiling for a good while. The Furnaces are kept at work Night and Day for many Months; ſtill ſupplying the Waſte of the Fuel, and other Materials, with freſh poured in at the Top.

From theſe Furnaces they bring their Sows and Pigs of Iron (as they call them) to their Forges. Theſe are of two ſorts, though ſtanding together under the ſame Roof; one they call their Finery, the other the Chafery. Both of them are upon Hearths, on which they place great Heaps of Sea-coal, and behind them Bellows like to thoſe of the Furnaces, but nothing near ſo large. Into their Finery they firſt put their Pigs of Iron, placing three or four of them together behind the Fire, with a little of one End thruſt into it: Where ſoftning by Degrees, they ſtir and work them with long Bars of Iron, till the Metal runs together in a round Maſs or Lump, which they call a Half-bloom. This they take out, and giving it a few Strokes with their Sledges, they carry it to a weighty Hammer, raiſed likewiſe by the Motion of a Water-wheel; where, applying it dexterouſly to the Blows, they preſently beat it out into a thick ſhort Square. This they put into the Finery again, and heating it red hot, they work it out under the ſame Hammer, till it comes to be the Shape of a Bar in the Middle, with two ſquare Knobs on the Ends. Laſt of all, they give it other Heatings in the Chafery, and more Workings under the Hammer, till they have brought their Iron into Bars of ſeveral Shapes and Sizes. If they omit any one Proceſs, it will be ſure to want ſome part of its Toughneſs, which they eſteem its Perfection.

For the Backs of Chimneys, Hearths of Ovens, or the like, they take the melted Metal out of the Receivers in great Ladles, and pour it into Moulds of fine Sand.

In Lancaſhire; *By Mr.* John Sturdy, *n.* 199. *p.* 695.

2. At *Milthorp* Forge in *Lancaſhire*, they have ſeveral ſorts of Iron Stone, ſome of it making *Coldſhire Iron*, that is, ſuch as is brittle when it is cold; another ſort makes *Redſhire*, that is, ſuch as is apt to break, if it be hammered when it is of a dark red Heat; and therefore they are never melted down but in Mixture, and ſo they yield an indifferent good ſort of Iron. They have of late made it much better than heretofore, by melting the *Sow-metal* over again, as likewiſe by uſing Turf and Charcoal; whereas formerly their Fuel was only Charcoal. They firſt burn the *Iron Stone*, and then, for every 17 Baſkets of this burnt Stone, they put in one of *Limeſtone* unburnt, to make it melt freely and caſt the Cinder; which they always take off from the melted *Iron* before they let it run.

The Bottom of the Furnace is about two Yards ſquare, and ſo riſes perpendicular for a Yard, or more; which is alſo lined within with a Wall of the beſt *Fire-ſtone*, to keep off the Force of the Fire from the Walls of the Furnace. The Bellows (which are very large, and played with Water) enter about the Middle of the *Focus:* The reſt of the Furnace is raiſed upon this, ſix or ſeven Yards ſquare-wiſe, but tapering; ſo that the top Hole (where they throw in Baſkets of Stone and Fuel) is but half a Yard ſquare. When they find it to have ſubſided about a Yard and an half, then they fill the Furnace again.

The *Ore* is got in *Furneſs* (a Diviſion of *Lancaſhire*) at leaſt 15 Miles from *Miltborp*, Some of it is hard, but feels ſoft and ſmooth on the outſide, like Velvet. Some is ſoft as Clay, but all is red; and one ſort ſeems to be good *Hæmatites*.

Ibid, p. 697.

2. The Forge is very much like that of a common Black-ſmith's, about a Yard and a half over, and the ſame height. The Hearth is all Sow-Iron, much of the ſhape of a broad-brim'd Hat, with the Crown downwards. This hollow Place they fill and heap up with Charcoal, and lay the *Ore* (firſt broken into pieces as big as a Pigeon's Egg) all round about the Charcoal upon the flat Hearth, to bake it, as it were, or neal it, and thruſt it in by little and little into the hollow, and keep blowing for ſome twelve Hours. Then they pull out a Stopple at the bottom of the Wall, and out comes all the Glaſſy Cinder, being very liquid, leaving the Iron (which is never in a perfect Fuſion) in a Lump at the bottom. This they take out with great Tongs, and turn it under heavy Hammers (play'd with Water) which at the ſame time beat off, or rather ſqueeze out, the fluid *Scoriæ* (eſpecially at firſt taking out of the Furnace) and from it, after ſeveral Heats, into Bars. They uſe no Limeſtone, or other things, to promote the Flux. They get about an hundred weight of Metal at one melting, which is the product of about three times ſo much *Ore*.

Ib. p. 699.

Steel is not made from that they call *Steel Ore*, but Iron, ſuch as is made from the reſt.

The ſeveral ſorts of *Ores* lie in one Vein, which is ſometimes an Inch, ſometimes a Foot, and ſometimes three or four Yards broad, and many Fathoms deep, between grey Limeſtone Rocks; but the hard *Ores* lie uſually next the Rocks on each ſide, and the ſoft *Ore* in the midſt. They uſe the ſoft *Ore* frequently, and with good Succeſs, as a Medicine for the Murrain in Cattle, and for all Diſeaſes in Swine, to which laſt they will give a good Handful, or two, in Milk.

By Dr. Liſter. ib.

3. This Clay *Hæmatites* is as good, if not better, than that which is brought from the *Eaſt-Indies*; witneſs the Tea-Pots made of it in *Stafford-ſhire*.

The true Way of making of Steel; *By Dr.* Mart. Liſter. n. 203. p. 865. *Vid. inf. Vol.* III. *par.* II. *Cap.* II. §. XLIV.

C. Thoſe famous and ſtupendous Monuments of Antiquity, the *Egyptian Obeliſks*, are all of *Porpbyry*, and moſt of them curiouſly carv'd with a vaſt number of Figures, one way of Writing of the antient *Egyptians*: Theſe witneſs the Facility that Nation had of Graving in *Porpbyry*; a Stone which no Tool will now touch, nor nothing leſs affect, than Emery or Diamond Powder.

Mr. *Ray* aſſures us, that all the *Obeliſks* of *Rome*, that are graven with *Hieroglyphicks*, are of one and the ſame kind of Stone, *viz.* a Marble of a mingled Colour, red and white, very hard, and hath not in ſo many Ages ſuffer'd the leaſt by the Weather.

Something there is certainly loſt in this Age, as to the manner of Steeling of Tools: And the Proceſſes now uſed by moſt Nations are fraudulent, and a poiſoning of Iron by certain mineral Salts, rather than a true making of *Steel*.

Meteor. l. 4. c. 6. *Ariſtotle* tells us, “ that wrought Iron it ſelf may be caſt ſo as to be made
“ liquid, and to harden again: And they are wont to make *Steel* thus; for
“ the *Scoria* of Iron ſubſides, and is purged off by the bottom. And when
“ it hath been often defecated and made clean, this is *Steel*. But this they
“ do not often, becauſe of the much Waſte, and for that it loſes much weight
“ in Fining. But Iron is ſo much the more excellent, the leſs Excrement it
“ hath.” This Account is a little confuſed, and not well underſtood: It is indeed true, that Iron is ſtill better the more it is purged. It is as true, that even wrought Iron may be melted as often as you pleaſe; and as oft as it is melted and purged, it loſeth much of its Weight. But after all, Iron of itſelf, how oft ſoever it is purged and refined, will never become *Steel*; yet of this ſo purged, the beſt *Steel* doubtleſs may be made.

De Re Metal. l. 9. The manner of making true *Steel*, is thus faithfully deſcribed by *Agricola*. And this way by *Kircher* is ſaid to be now in uſe in the Iſland of *Ilva*, a Place famous from all Ages, even from the Times of the *Romans*, for that Metal alone, down to our Days.

“ Make choice of Iron which is apt to melt, and yet hard, and which
“ may eaſily be wrought with the Hammer; for altho' Iron which is made
“ of Vitriolick *Ore*, may melt, yet it is ſoft, or fragil, or eager. Let a
“ parcel of ſuch Iron be heated red hot, and let it be cut into ſmall pieces,
“ and then mixt with a ſort of Stone which eaſily melts; then ſet in the
“ Smith's Forge, or Hearth, a Crucible, or Diſh of Crucible Metal, a
“ Foot and a half broad, and a Foot deep; fill the Diſh with good Charcoal,
“ and compaſs the Diſh about with looſe Stones, which may keep in
“ the mixture of Stone and pieces of Iron put thereon.

“ As ſoon as the Coal is thoroughly kindled, and the Diſh is red hot, give
“ the blaſt, and let the Workman put on, by little and little, all the mixture
“ of Iron and Stone he purpoſes.

“ When it is melted, let him thruſt into the middle of it three or four, or
“ more pieces of Iron, and boil them therein five or ſix Hours, with a ſharp
“ Fire; and putting in his Rod, ſtir often the melted Iron, that the pieces of
“ Iron may imbibe the ſmaller Particles of the melted Iron, which Particles
“ conſume, and thin the more groſs Particles of the Iron Pieces; and are,
“ as it were, a Ferment to them, and make them tender.

“ Let the Workman now take one of the Pieces out of the Fire, and put
“ it under the great Hammer, to be drawn out into Bars, and wrought;
“ and then hot as it is, forthwith plunge it into cold Water.

“ Thus temper'd, let him again work it on the Anvil, and break it; and
“ looking upon the Fragments, let him conſider whether it looks like Iron
“ in any part of it, or be wholly condenſed, and turned into *Steel*.

“ Then let the Pieces be all wrought into Bars; which done, give a freſh
“ Blaſt to the Mixture, adding a little freſh Matter to it, in the room of
“ that which had been drunk up by the pieces of Iron; which will refreſh
“ and ſtrengthen the Remainder, and make yet purer the pieces of Iron again

“ put into the Diſh: Every one of which let him, as ſoon as it is red hot, “ beat into a Bar, upon the Anvil, and caſt it, hot as it is, into cold Wa- “ ter. And thus Iron is made into *Steel*, which is much harder and whiter “ than Iron.

Pliny, ſpeaking of Iron, ſays, *Fornacum maxima differentia eſt; in iis equidem Nucleus ferri excoquitur ad indurandum aciem, alioque modo ad denſandas incudes malleorumve roſtra.* From this Paſſage it ſhould ſeem that the Antients had one way to make the *Steel*, and another way to harden or temper their Tools, particularly ſuch as Picks and Anvils. And it is plain, that the *Nucleus Ferri* (by which muſt be meant well purged Iron, the ſame which *Ariſtotle* calls εἰργασμένος σίδηρος) was melted down in both. But, in my Opinion, with this difference, in making *Steel* they not only boiled their Iron in its own Sow-Metal, or liquid Iron, but hammer’d it alſo, and after quenched it in cold Water.

Lib. 34. c. 14.

And this Opinion thoſe other Words of *Pliny*, in the next Chapter, favour, *Ferrum accenſum Igni, niſi duretur ictibus, corrumpitur*: And again, *Aquarum ſumma differentia eſt, cui ſubinde candens immergitur.* And this way was ſufficient for Sword-Blades, and Knives, Razors, *&c.* Whereas in ſteeling their Tools, they boiled their Tools in Sow-Metal, to ſuch a degree of Hardneſs or Temper as was requiſite, and did not afterwards hammer them. For Iron this way made into *Steel*, becomes a kind of *Electrum*, and is filled with an exceeding brittle and hard Body; for which purpoſe the Word *Denſare* is, by *Pliny*, aptly and elegantly uſed. And this way was uſed when the ſtrongeſt Temper and Hardneſs was required, as to Picks and Anvils: For it is certain that *Steel*, as well as Iron, by Ignition, is ſpoiled or corrupted. Hence it was that the Antients well knowing, that in making their Tools out of *Steel*, they could not but conſiderably loſe and abate of their Temper; they firſt ſhaped them, and then gave them a ſtrong Body of *Steel* and Temper together, and ſo had nothing elſe to do but to finiſh them on the Grindſtone and Hone, to ſet the Point or Edge.

CI. 1. *Herrn-Ground* is a little Town in *Hungary*, ſeated very high between two Hills, upon a part of Land of the ſame Name, an *Hungarian* Mile diſtant from *Newſol.* In this Town is the Entrance into a large *Copper* Mine, very much digged.

Copper Mines in Hungary; *By* Dr. Edward Brown n. 59. p. 1042.

I went in thro’ a *Cuniculus*, called *Taeb-ſtoln*. The ſteep Deſcents are made by Ladders or Trees ſet upright, with deep Notches or Stairs cut in them to ſtay the Foot upon. They are not troubled with Water, the Mine lying high in the Hill: But they are moleſted with Duſt and Damps.

The Veins of this Mine are large, many of them cumulate, and the *Ore* very rich: in an hundred Pounds of *Ore* they ordinarily find twenty Pounds of *Copper*; ſometimes thirty or forty, half *Copper*, and even to ſixty in the Hundred. Much of the *Ore* is joined ſo faſt in the Rock, that it is ſeparated with much difficulty. There are divers ſorts of *Ore*; but the chief difference is between the yellow and the black; the yellow is pure *Copper Ore*, the black contains alſo a proportion of Silver.

They find no *Quick-ſilver* here; the *Mother* of the *Ore* is yellow, and the *Copper-Ore* heated and caſt into Water, maketh it become like that of ſome ſulphureous Baths.

They ſeparate the *Metal* from the *Ore* with great Difficulty. The *Ore* commonly paſſes 14 times through the Furnace: Sometimes it is burned and other times melted, ſometimes by itſelf, and ſometimes mixed with other Minerals and its own Droſs.

There are divers ſorts of *Vitriol* found in this Mine, green, blue, reddiſh, and white. There is alſo a green Earth, or Sediment of a green Water called *Berggrun*; there are likewiſe Stones found of a beautiful green and blue Colour, and one ſort on which *Turcoiſes* have been found; therefore called the *Mother* of the *Turcois*.

There are alſo two Springs of a vitriolate Water, which are affirmed to turn Iron into Copper; they are called the *old* and the *new Zimeut*; theſe Springs lie deep in the Mine: The *Iron* is ordinarily left in the Water 14 Days; I took divers Pieces formerly *Iron*, now appearing to be *Copper*, out of the *Old Zimeut*; they are hard within the Water and do not totally loſe their Figure, and fall into Powder, they will eaſily melt without the Addition of any other Subſtance.

They make handſome Cups and Veſſels out of this ſort of *Copper*.

In Lancaſhire *and* Cumberland; *By Mr.* Dav. Davies, *to Dr.* Liſter. n. 200. *p.* 737.

2. There is a Heap of *Copper-Ore* by *Darwent* near *Keſwick*, but I ſuppoſe the Weather hath eaten out all the *Copper* that was in it: It is reported, that the thickneſs of the Vein at *Gouldſcope* in *Newlands* was ſix Foot; there are no Shafts now in being either at *Newlands* or *Caldbeck*, there are divers Adits, but they are uſeleſs, the Workmen have wrought down the *Ore* far below them; there is part of an Adit wrought at *Caldbeck*, but it is uncertain what it coſt finiſhing; for ſome Stone may be wrought for 20 Shillings a Fathom, and ſome of it may prove ſo hard, that it may coſt 10 Pound a Fathom.

A Thouſand Pound Stock will be enough to begin with, to get *Ore* at *Caldbeck* Mines, and then there muſt be melting Houſes built, which coſt 500 Pound or more; and before *Copper* be made ready for Sale at the Market, and the Work come to pay itſelf, it will be ſix or ſeven Years at leaſt, and by that time 10000 will be Stock little enough.

By---*to Dr.* Liſter. ib. p. 741.

3. The firſt Work that was found, and wrought in by the *Dutch Men*, in *Coniſton Fells*, is called Low Work, it hath a Stulm or Shaft to draw Water from the Mine. This Work was left good, and hath been wrought from the Day to the Evening End of the ſaid Work 40 Fathoms, or thereabouts; the Seam or Vein of *Copper-Ore* then left was above three quarters of a Yard thick of good *Ore*; which Seam or Vein did go from the Evening End to the Morning End of the ſaid Work, and was eſteemed 200 Fathoms betwixt, wrought as the Vein went, and was, when left, all near of a breadth or thickneſs. The *Copper-Ore* in this Work was mixed with ſome *Silver* or *Lead-Ore*.

The ſecond Work is called White Work or New Work, about Forty

Fathom from the firſt, was wrought about 10 Fathom deep; the Seam then left was about 22 Inches of good Copper-Ore.

The third is called *Tung-Brow*, a little diſtant from the laſt, being wrought about 30 Fathom, and the Seam about two Foot thick of the like Ore.

The fourth is called *God's Bleſſing*, or *Thurdlehead*, being wrought about 30 Fathom, and being from the laſt Mine about a Mile, the thickneſs of the Seam of Ore above a Yard, when left off, and thought to be much of it Gold-Ore.

The fifth, called *Hen-Cragg*, is a Mile from the laſt, wrought about two Fathoms; a ſmall Seam, but excellent Ore.

The ſixth Work is called *Sumy-Work* at *Levers Water*, at the Water-ſide, and a little above that, *Hanch Clocker*'s *Work*; a little above that, *George Tower*'s and *William Dixſon*'s *Work*; *Bartle Clocker*'s *Work*; near the laſt, *Richard Tower*'s *Work*; then *John Saclock*'s *Work*; and *Hanch Mire*'s *Work*; being all ſeven Works, and lie all together, and about a Mile from the fifth Work aboveſaid; and wrought about 10 or 12 Fathom; the Seam of Ore about 16 Inches thick; the Stone very ſoft, and the Ore very rich, and much of the ſaid Ore, green. If the Turn was drained, it is thought that all theſe ſeven Works would come into one, and that it would be the beſt Work that ever was in theſe Parts.

The ſeventh Work is called *Gray-Cragg-Beck*, wrought but a little, the Seam about 18 Inches thick, of as good Ore as any of the other Works.

The eighth is called *John Dixſon*'s *Work* in *Brumſel*, was wrought about two Fathom, the Seam about 24 Inches thick, and eſteemed the beſt *Ore*, except *God's Bleſſing*, it is about half a Mile from the laſt Work.

The ninth Work is called the *Wide Work*, or *Thomas Hirn*'s *Work*, wrought about 60 Fathom, and left a Seam above 26 Inches thick, when the Work was given over, of very good *Ore*. It has a Shaft or Pump to draw the Water away, and it is from the laſt Work about two Miles.

The tenth Work is called *Three Kings* in *Tilburthwait*, being Three Works, and wrought about 40 Fathom a-piece, the Seam being about 14 Inches of very good *Ore*.

Theſe are all the Works that have been wrought in *Coniſton-Fells*: Moſt of them have ſmall Seams near the *Copper*, of a gray ſort of *Ore* in ſmall Thread.

There are lately diſcovered Three Veins in *Torverwel*, and about 10 in other Places, and all within two Miles of the firſt Work in *Coniſton-Fells*, and as hopeful as thoſe that have been wrought in.

When the *Ore* that was got at *Coniſton*, came to be ſmelted at *Keſwick*, they found it ſo much to exceed the *Copper-Ore* of either *Caldbeck* or *Newlands*, that they let fall theſe Works, and ſent the Workmen to *Coniſton-Fells*; ſo that there were 140 Men kept conſtantly at the Works there; and the *Ore* that they got, did ſufficiently furniſh and ſupply the Smelt-Houſes at *Keſwick*.

The Rate that was given for getting of *Copper-Ore*, was according to its Goodneſs, from eight Shillings a Kibble to two Shillings and Six-pence, every Kibble being near a Horſe-Load in Weight, it being firſt beaten very ſmall, waſhed and ſifted through an Iron Sieve, then meaſured or weighed.

There was near the firſt Work a Stamp-Houſe, which went by Water, and ſeveral Perſons were employed to bring the Refuſe from each Work, that the Miners did throw away, to the Stamp-Houſe, where it was ſtamped, waſhed, and ordered, and they had two Shillings and Sixpence for their Pains.

To make Braſs. *by Mr.* Tho. Povey, *n.* 200. *p.* 735. *n.*260.*p.*474.

CII. *Calamine* is digged out of ſeveral Mines in the *Weſt* of *England* (as about *Mendip*, &c.) about 20 Foot deep. It is burned or calcined in a Kiln or Oven made red hot, then ground to Powder, and ſifted into the fineneſs of Flour, then mixed with ground Charcoal, becauſe the *Calamine* is apt to be clammy, to clod, and not ſo apt or capable of incorporating. Then they put ſeven Pound of *Calamine* into a Melting-Pot, of about a Gallon content, and about five Pound of *Copper* uppermoſt; the *Calamine* muſt be mixed with as many Coals as will fill the Pot. This is let down with Tongs into a Wind Furnace, eight Foot deep, and remains 11 Hours therein; they caſt off not above twice in 24 Hours. One Furnace holds eight Pots. After melting, it is caſt into Plates or Lumps.

Forty-five Pound of raw *Calamine* produces 30 Pound burnt or calcined.

Braſs Shruff ſerves inſtead of ſo much Copper, but this cannot always be procured in Quantities, becauſe it is a Collection of Pieces of old Braſs, which is uſually procured in ſmall Parcels.

The beſt Guns are not made of malleable Metal, and cannot be made of pure Copper or Braſs, but it is neceſſary to put in coarſer Metals to make it run cloſer and ſounder, as Lead, and Pot-metal; Bell-metal being Copper and Tin; and Pot-metal Copper and Lead. About 20 Pound of Lead is uſually put into 100 Pound of Pot-metal; but about 6 Pound is ſufficient to put into 100 Pound of Gun-metal.

The *Calamine Stones* were heretofore fetched from *Poland*, but ſince fetched from hence by the *Dutch*.

The Manufacture of Braſs was privately kept in *Germany* for many hundred Years; wherein many Thouſands were employed, and all were maintained; ſome having thereby raiſed themſelves to great Eſtates.

The Tin Mines *in* Devonſhire, *and* Cornwal, *By* . . *n.*69.*p.*2096.

CIII. It is ſuppoſed by the Miners, that there was a great Concuſſion of the *Waters* in that *Separation of the Waters from the Waters* at the *Creation*, when the dry Land firſt appeared, or at *Noah*'s Flood, or at both times: Whereby the *Waters* moved and removed the (then) Surface of the Earth. That till then the uppermoſt Surface of Mineral Veins, or Loads, (did in moſt Places) lie even with the (then real, but now imaginary) Surface of the Earth, which is now called the *Shelf*, or *Faſt Country*, or Ground that was never moved. But at this Concuſſion of the Waters, the Surface of the Earth, together with the uppermoſt of theſe Mineral Veins, were looſed, and torn off; and by the deſcending of the Waters into the Valleys, both the Earth, or

Grewt, and thoſe Mineral Stones or Fragments ſo torn off from their Loads (which are conſtantly termed *Shoad*) were together with, and by the Force of the Waters carried beneath their proper Places, and from ſome Hills, even to the Bottoms of the neighbouring Valleys; and from thence by Land-Floods many Miles down the Rivers.

Training a Load.

1ſt, Upon theſe Suppoſitions, we proceed in training a Load, thus:

1. Where we ſuſpect any *Mine* to be, we diligently ſearch that Hill and Country, that we may the better know the *Grewt* and *Stones*, when we meet with them at Diſtance in the neighbouring Valley.

2. Then we obſerve the Frets in the Banks of Rivers that are newly made by any great Land-Flood, which uſually are then very clean, to ſee, if haply we can diſcover any metalline Stones in the Sides and Bottoms thereof, together with the Caſt of the Country (*i. e.* any Earth of a different Colour from the reſt of the Bank) which is a great Help to direct us, which Side or Hill to ſearch into. The Mineral Stones are diſcovered either by their Ponderouſneſs, or by their Poroſity, for moſt Tin Stones are porous, not unlike great Bones, almoſt thoroughly calcined; yet Tin ſometimes lies in the firmeſt Stones: Or by Vauning, which is performed by Pulverizing the Stone or Clay, or what elſe may be ſuſpected to contain any Mineral Body, and placing it on a Vauning-ſhovel; the Gravel remains in the hinder Part, and the Metal at the Point of the Shovel, whereby the Kind, Nature, and Quantity of the Ore is very nearly gueſs'd at.

3. If no *Shoad* be found in theſe Frets, we truſt not to any found in the River, it being uncertain from whence the Water may have brought them. But we go to the Side of thoſe Hills moſt ſuſpected, where there may be a conveniency of bringing a little Stream of Water, the more the better, and cut a Leat, Gurt, or Trench, about two Foot over, and as deep as the Shelf, in which we turn the Water to run two or three Days; by which time the Water, by waſhing away the Filth from the Stones, and the looſer parts of the Earth, will eaſily diſcover what *Shoad* is there. If we find any, we have a Certainty of a Load in the upper Part of the Hill, or at leaſt a Squat.

4. Sometimes *Shoad* may be found upon the open Surface of the Ground, but then it is brought thither by ſome Accident; for the Corruption of Vegetables and other Creatures, have in a long Tract of Time ſince the Deluge, begotten a new Surface, heightened in ſome Places a Foot or more above the Shelf; and this is demonſtrable to the Eye in every Tin Work.

5. At the Foot or Bottom of the Hill, we ſink an Eſſay Hatch, or a Hole about ſix Foot long, and four Foot broad, and always as broad as the Shelf. If we find no *Shoad* before, or when we come to the Shelf, there is none to to be expected: Yet ſometimes the *Shoad* is waſhed away clean, when you come within two or three Foot from the Load, which then lies ſo much farther up in the Hill. If we find *Shoad*, we are almoſt at a Certainty: And this is held as an infallible Rule, That the nigher the *Shoad* lies to the Shelf, the nigher the Load is at hand, & *vice verſa*.

6. If we find no *Shoad* in this firſt Hatch, we aſcend commonly about 12 Fathom, and ſink a ſecond Hatch, as the former. And in caſe none appear in,

this, we go then as many Fathom on each hand at the ſame height, and ſink there as before; and ſo aſcend proportionably with three or more Hatches, if the ſpace of Ground requires, as it were in Breaſt, till we come to the Top of the Hill: and if we find none in any of theſe Hatches, then farewel to that Hill.

7. But if we find any *Shoad* in any of theſe Hatches, we keep our aſcending Hatches in a direct Line; and as we draw nearer the Load, we leſſen our firſt proportion of 12 Fathom, to ſix or leſs, as our Conjecture guides us.

8. If finding *Shoad* lying near the Shelf in one Hatch, and none in the next aſcending, we conclude that we have certainly over-ſhot the Load; and then we ſink nigher the Hatch, wherein we laſt found *Shoad*.

9. Sometimes we find two different *Shoads* in the ſame Hatch at different Depths, and then we have a certainty of another Load above the former; and it may be in training up to the ſecond, we meet with the *Shoad* of a third. Some Tinners affirm, that ſeven Load may lie parallel to each other in the ſame Hill, but yet only one Maſter Load; the other ſix, three on each ſide, being the leſſer Concomitants. So may five lie in like manner; three are common.

10. Every Load has, as it were, a peculiar coloured Earth or Grewt about it, which is found likewiſe with the *Shoad* in a greater quantity, the nearer the *Shoad* lies to the Load, and ſo leſſened by degrees to about a quarter of a Mile's Diſtance; farther than which, that peculiar Grewt is never found with the *Shoad*.

11. A Valley may ſo lie, as at the Feet of three ſeveral Hills; and then we may find three ſeveral Deads, *i. e.* common Earth, or that looſe Earth which was moved with the *Shoad* in the Concuſſion, but not contiguous to the Load in its firſt Poſition, which is alſo term'd by us the Run of the Country, with as many different *Shoads* in the midſt of each. And here the Knowledge of the Caſt of the Country, or each Hill, in reſpect of its Grewt, will be very neceſſary, for the ſurer training of them one after another, as they lie in order, according to the foregoing Rules of Eſſay Hatches; for the uppermoſt will direct you, with which Hill to begin firſt.

12. It may be, that after we have trained up the Hill, inſtead of a Load, we find nought but a Bonny or Squat, which likewiſe have their *Shoad*, whoſe Form is about two or three Fathom long, and half as broad; few larger, moſt leſs, which communicates with no other Load or Vein, neither doth it ſend forth any of its own, but is entire of itſelf, and may go down into the Shelf five or ſix Fathom deep, and there terminate.

Digging the *Ore.* ib. p. 2101.

2*dly*, When we have found the Load, the laſt Eſſay Hatch is then called a Tin Shaft, or Tin Hatch, which we ſink down about a Fathom, and then leave a little long ſquare Place, termed a Shamble, and ſo continue ſinking from Caſt to Caſt, *i. e.* as nigh as a Man can conveniently throw up the Ore with a Shovel, till we find either the Load to grow ſmall, or degenerate into ſome ſort of Weed, which are divers; as *Mundick*, or *Maxy* corrupted from *Marchaſite*, white, yellow, and green; *Daze*, which is a kind of glittering

Stone enduring the Fire, of different Colours, white, black, and yellow; *Iron-mould*, black, and ruſty; *Caul*, red, (differing both from *Mundick* and *Sparr*, enduring the Fire) which *Marchaſite* will not; *Gliſter*, blood-red, and black.

2. We then begin to make a Drift three Foot wide, and ſeven high: And if the Load he not broad enough of it ſelf, as ſome are ſcarce half a Foot, then we uſually break down the Deads, or that part of the Shelf which contains no Metal, but encloſeth the Load, as a Wall, between two Rocks; and then we begin to rip the Load it ſelf.

3. The Inſtruments we make uſe of, are, 1. A Beele, or *Corniſh* Tubber, *i. e.* double Points, of eight Pound or 10 Pound weight, ſharped at both Ends, well ſteel'd and holed in the middle: it may laſt in a hard Country half a Year, but new pointed every Fortnight at leaſt. 2. A Sledge, flat headed, from 10 Pound to 20 Pound weight, 'twill laſt about ſeven Years, new order'd once a Quarter. 3. Gadds or Wedges of two Pound weight, four ſquare, well ſteel'd at the Point; they will laſt a Week; two or three Days, then ſharpened. 4. Ladders. 5. Wheel-Barrows, to carry the Deads and Ore out of the Drifts or Adits, to the Shambles.

4. There are two Shovel-men and three Beele-men, which are as many as one Drift can contain, without being an Hindrance to each other. The Beele-men rip the Deads and Ore, the Shovel-men carry it off, and land it, by caſting it up with Shovels from one Shamble to another, unleſs it be where we have a Winder with two Keebles, or Buckets, one of which comes up as the other goes down.

5. It is generally obſerved, that moſt of our Tin Loads run from Weſt to Eaſt, and then they conſtantly dip towards the North; ſometimes they underlie, that is, ſlope down towards the North, three Foot in eight perpendicular: Yet in the higher Mountains of *Dartmoor* there are ſome conſiderable Loads, which run North and South, theſe underlie towards the Eaſt.

6. Four or five Loads may run parallel to each other in the ſame Hill, and yet, which is rare, meet altogether in one Hatch, as it were in a Knot, which well tins the Place, and ſo ſeparate again, and keep their former Diſtances: Such a Knot hath been obſerved and wrought on *Hingſton*, a known mineral Down or Common in *Cornwal*.

7. The Breadth of Maſter Loads may generally be from three to ſeven Foot, ſeldom larger, unleſs where ſeveral Loads may chance to make a Knot, or ſend forth Strings or Veins. Neither retain they their uſual Breadth in all parts; for they may be ſix Foot at once place, and not two at another, nay, ſometimes ſcarce half an Inch over; but that is to be underſtood of Strings, and the narroweſt Places of the concomitant Loads.

8. The Load is uſually in a hard rocky Country, made up of Metal, Spars, and other Weeds, as it were all along a continued Rock: But it hath many Veins and Joints, as we ſpeak; but in ſome ſofter Countries, the Tin may lie in a ſofter Conſiſtence, as that of Clay in a manner petrefied.

9. In moſt Places we meet with Water at ſome Feet deep from the loady Surface, in other ſome not at many Fathoms deep. It runs continually thro

the Heart of the Load. When it begins to trouble us, we begin at the Foot of the Hill a Drift, or Adit, ſcarce half ſo big as that of the Load, and work it on a Level, till we come up to the Load. But if we have not this Conveniency of an Adit, or if we paſs that Level, we are forced to draw it with Winders and Keebles, or with Pumps. Some, but very few, Works may be dry.

10. We obſerve that if we have Water, we never want Air ſufficient for Reſpiration, and our Candles to burn in; yet ſometimes, in a ſoft clayie Country, our Air is ſo much condenſed, that it becomes in a manner a Damp, and requires an Air-ſhaft for vent; which Damps are ſometimes enlarged by working of the *Mundick* with the Ore.

11. If the Country be not ſtrong enough, we underprop our Drifts with Stemples and Wall-plates, placed much like a Carpenter's Square, on the one ſide, and over head.

12. To know which way the Load inclines, or to bring an Adit, or to ſink an Air-ſhaft to the deſired Place, the Uſe of the Dial is needful, which we term Plumming and Dialling, and is thus performed. A ſkilful Perſon firſt faſtens the end of a long Line at a known Place, and then exactly obſerves the Point at which the Needle of his Dial, or Compaſs, reſts; and at the next Flexure he makes a Mark on the Line, and again notes the Point at which the Needle ſtands at this ſecond Station; and ſo proceeds from Turning to Turning, ſtill marking the Points, and his Line, till he comes to the intended Place. He then repeats above-ground what he had done below, and his Dial and Line lead him, till he comes exactly over the Place where he ended in the Mine.

Dreſſing of the Tin.

3. When the Ore is landed, and the greater Stones broken at the top of the Mint by the Shovel-men, 'tis brought on Horſes to the Stamping or Knocking Mills, and unloaded at the head of the Paſs (*i. e.* 2 or 3 bottom Boards with 2 ſide Boards ſloping-wiſe) in which the Ore ſlides down into the Coffer: But that it may not tumble down all at once, there is placed a Hatch nigh the lower end of the Paſs (*i. e.* a thwart Board to keep up the Ore) beneath that comes in the Cock-water in a Trough cut in a long Pole, which with the Ore, falls down into the Coffer, *i. e.* a long ſquare Box of the firmeſt Timber, 3 Foot long, and $1\frac{1}{2}$ Foot over, wherein the 3 uſual Lifters, plac'd between 2 ſtrong broad Lones, having 2 Braces, or thwart pieces, on each ſide to keep them ſteady as a Frame, with Stamper-heads weighing about 30 or 40 Pound a-piece, of Iron, which ſerve to break the Ore in the ſaid Coffer. Theſe Lifters about 8 Foot long, and $\frac{1}{2}$ a Foot ſquare, of Heart-Oak, and having as many In-timbers, or Guiders, between them, are lifted up in order by double the number of Tappels, faſtened to as many Arms paſſing diametrically through a great Beam, turned by an over-ſhot Water-wheel, on two Boulſters, which exactly, but eaſily, meet with the Tongues ſo placed in the Lifters, as that they quickly ſlide from each other, ſuffering the Lifters to fall with great force on the Ore, thereby breaking it into ſmall Sand, which is waſhed out by the Cock-water, thro' a Braſs Grate, holed very thick, and placed within two Iron Bars at one End of the Coffer into the Launder, *i. e.* a

Trench cut in the Floor, 8 Foot long and 10 Foot over, ſtopped at the other End with a Turf, ſo that the Water runs away, and the *Ore* ſinks to the Bottom; which when full, is taken up and emptied with a Shovel.

2. The *Stamping-Mill* is thus contrived to go two Hours, or more, after we give over our Attendance on it. We have a Tiller, *i. e.* a long Pole faſtened without at one End to the *Slew*, or *Ponder*, *i. e.* that looſe and laſt part of the Trough that conveys the Stream to the Mill-wheel; and at the lower End is tied a ſhort Rope, with a tranſverſe Stick at the End of it, curiouſly, but trap-ways hitcht at both Ends under two little Pins, faſtned in the *Lones* for that purpoſe. There is another Pin ſet in one of the *Lifters*, at ſuch an exact height, as that if there be no *Ore* in the Coffer to keep that *Lifter* high enough, the purpoſed Pin, in deſcending, knocks out the Water, carrying it quite over the Mill-wheel: ſo that when the Coffer is emptied, the Mill reſts of its own accord.

3. The *Launder* is divided into three parts, *i. e.* the *Forehead*, the *Middle*, and the *Tail*. That *Ore* which lies in the *Forehead*, *i. e.* within 1¼ Foot of the Grate, is the beſt *Tin*, and is taken up in a Heap apart. The *Middle* and *Tails* in another, accounted the worſt.

4. The latter Heap is thrown out by the *Trambling Buddle*, *i. e.* a long ſquare Tye of Boards, or Slate, about four Foot deep, ſix long, and three over; wherein ſtands a Man bare-footed, with a *Trambling-Shovel* in his Hand to caſt up the Ore, about an Inch thick on a long ſquare Board juſt before him, as high as his Middle, which is termed the *Buddle-head*; who dexterouſly, with the one Edge of his Shovel, cuts and divides it longways, in reſpect of himſelf, about half an Inch aſunder; in which little Cuts the Water coming gently from the Edge of an upper plain Board carries away the Filth and lighter part of the prepared Ore firſt, and then the *Tin* immediately after; all falling down into the *Buddle*, where, with his bare Foot, he ſtroaks and ſmooths it tranſverſly, to make the Surface the plainer, that the Water and other heterogeneous Matter may, without Let, paſs away the quicker.

5. When this *Buddle* grows full, we take it up, here diſtinguiſhing again the *Forehead* from the *Middle* and *Tails*, which are trambled over again: But the *Forehead* of this, with the *Forehead* of the *Launder*, are trambled in a ſecond *Buddle*, but not different from the firſt, in like manner. The *Forehead* of this being likewiſe ſeparated from the two other parts, is carried to a third, both *Drawing Buddle*, whoſe Difference from the reſt is only this, that it hath no Tye, but only a plain ſloaping Board, whereon it is once more waſhed with the *Trambling-Shovel*, and ſo it new names the Ore, *Black-Tin*, *i. e.* ſuch as is compleatly ready for the *Blowing-Houſe*.

6. We have another more curious way termed *Sizing*, that is, inſtead of a *Drawing Buddle*, we have an Hair Sieve, thro' which we ſift, caſting back the remainder in the Sieve into the *Tails*, and then new tramble that Ore. After the ſecond Trambling, we take that *Forehead* in the ſecond *Buddle*, and dilve it, *i. e.* putting it into a Canvas Sieve, in a large Tub of Water luſtily ſhake it, ſo that the Filth gets over the Rim of the Sieve, leaving the

Black-Tin behind, which is put into Hogſheads, covered and locked, till the next Blowing.

7. The *Tails* of both *Buddles*, after two or three Tramblings, are caſt out into the firſt *Strake* or *Tye*, which is a Pit purpoſely made to receive them, and what over-ſmall *Tin* elſe may waſh away in Trambling. There are commonly three or four of them ſucceſſively, which contain two ſorts of *Tin*; the one which is too ſmall, the other too great. The latter is new ground in a Craze Mill, in all reſpects like a Greiſt Mill, with two Stones, the upper and the nether, and after that trambled in order; the former by reaſon of its exceeding ſmallneſs, is dreſſed on a Reck, provided for that purpoſe, that is, a Frame made of Boards about three Foot and a half broad, and ſix long, which turns upon two Iron Pegs faſtened in both Ends, and the whole placed on two Poſts, ſo that it hangs in an *Æquilibrium*, and may, like a Cradle, be eaſily moved either Way, with the Shovel and Water.

Blowing of Tin.

4. When we perceive much *Mundick* in our *Tin*, which makes it britly hard, we are neceſſitated to burn away the Weed in a *Tin Kiln*; this Kiln is four ſquare, and at the Top a large Moor Stone, about ſix Foot long, and four broad; in the Middle thereof is an Hole made about half a Foot Diameter. About a Foot beneath this Stone, is placed another not ſo long by half a Foot, becauſe it muſt not reach the innermoſt or back part of the Wall, which is the open Place thro' which the Flame aſcends from a leſſer Place below that where a very ſtrong Fire of Furze is conſtantly made. The fore-part is like a common Oven; but near the back on the one ſide, there is another little ſquare Hole. When the Kiln is thoroughly heated, the *Black-Tin* that is to be burnt, is laid on the top Stone, and as much of it is caſt down at the ſquare Hole upon the 2d, or bottom Stone, as will cover it all over about 3 or 4 Inches thick; then the Hole at the Top is immediately covered with green Turfs, that the Flame may reverberate the ſtronger: And a Rake-Man with an Iron Coal-rake, conſtantly ſpreads and moves the *Tin*, that all Parts of the *Mundick* may get uppermoſt of the *Tin*, and ſo be burned away; which we certainly know by this, that then the Flame will become yellow, (as uſual) and the Stench leſſened; for whilſt the *Mundick* behind burns, the Flame is exceeding blue; then with the Rake he thruſts it down at the open Place into the open Fire, and receives a new ſupply of *Tin* from above. Now when the Place beneath, where the Fire is made, grows full of *Tin*, Coals and Aſhes, with his Rake he draws it forth with the Coals, at the little ſquare Hole on one Side, near the Back, where the Ore (fiery hot and red) is in the open Air to cool, which will ſcarce be in three Days, becauſe of the Coals that lie hid in it: But in caſe we cannot ſtay ſo long, then we quench it with Water, and it is like Mortar. Albeit we let it cool of itſelf, or with Water, we muſt new tramble it, or waſh it, as before, before we put it into the Furnace, which is no other than an *Alman Furnace*. *Moor-Tin*, *i. e.* ſuch as is digged up in the Moors, we find runs or melts beſt with *Moor-Coal*, *charked*: But our *Tin* which lies in the Country, runs beſt with an equal Proportion of Charcoal and Peate, *i. e. Moor-Coals*, for the firſt Running; but when we come to remelt our Slags, then we uſe Charcoal. When

all is melted down and remelted, there ſometimes remains a different Slag in the Bottom of the Float, which we term *Mount Egg*, and that is moſt an Iron Body, though of a Tin Colour; as I accidentally aſſured myſelf, by applying one of the Poles of a *Load-Stone* to it, and quickly attracted it, yet not ſuch a quantity, by far, as that of Iron.

By Dr. Chr. Merret, *n.* 138. *p.* 949.

2. The Stones from which *Tin* is wrought, is moſt uſually found betwixt two Walls of Rocks, which are generally of an Iron Colour, of little or no Affinity with the *Tin*, in a Vein of *Lead* (as the Miners call it) betwixt 4 and 18 Inches broad, or thereabout. Sometimes there is a rich and fat Metal, ſometimes hungry and ſtarved; ſometimes nothing but a droſſy Subſtance, not purely Earth, nor Stone, nor Metal; but a little reſembling the rejected Cinders of a Smith's Forge, appearing ſometimes of a more flouriſhing Colour tending to Carnation, and ſometimes more umbratile; and where this is found, the Miners judge the Metal to be ripe. The Pits are ſometimes above 60 Fathoms deep.

The Load being very rich and good, above that is 10 Fathoms from the Graſs or thereabouts. And below that, there is a ſtrange Cavity, or empty Place, wherein is nothing but Air for many Fathoms deep, as the Miners have tried with long Poles and Pikes. This Cavity lies between hard ſtony Walls, diſtant one from another about 6 or 9 Inches. The Labourers tell Stories of Sprights of ſmall People, as they call them; and that when the Damp ariſeth from the ſubterranean Vaults, they hear ſtrange Noiſes, horrid Knockings, and fearful Hammerings. Theſe Damps render many lame, and kill others outright, without any viſible Hurt upon them.

Though *Tin*, for the moſt part, be made from the Stones in which it is incorporated, yet ſometimes it is, as it were, mixed with a ſmall gravelly Earth, ſometimes white, but for the moſt part red. From this Earth it is eaſily ſeparated with bare Waſhing: This gravelly *Tin* is called *Pryan Tin*; and is ſcarce of half the Goodneſs of the other.

The *Mundick Ore* is eaſily diſcovered by its glittering, yet ſad brownneſs wherewith it will ſoon colour your Fingers. This is ſaid to nouriſh the *Tin*, and yet they ſay, where much *Mundick* is found, there is little or no *Tin*. Certain it is, If there be any *Mundick* left in melting the *Tin*, it makes it thick and cruddy, that is, not ſo ductile as otherwiſe; and therefore uſually draws down the Metal to an abatement, from 5 Shillings to 8 Shillings in the Hundred weight. This *Mundick* ſeems to be a kind of Sulphur. Fire only ſeparates it from the *Tin*, and evaporates it into Smoak. Little Sprigs or Boughs being ſet in the Chimney, the Smoak gathers upon them, into a Subſtance which they call Poiſon, and think it a kind of *Arſenick*, which being put into Water, eaſily diſſolves and produces very good *Vitriol*. The Water wherein it is diſſolved, ſoon changes ſmall Iron Rods put into it; and they ſay, that in a very little time it will aſſimilate the Rods into its own Nature. 'Tis generally concluded, that Fiſh will die in thoſe Waters whereinto *Mundick* is caſt, and they commonly impute the Death of ſome of their Neighbours to the drinking of *Mundick* Waters. When they burn it, to ſeparate it from *Tin*, there proceeds from it a Stench very loathſome and dangerous.

There alſo occurs a ſort of a *Sparr*, of a ſhining whitiſh Subſtance, which caſteth a white Froth upon the Water in waſhing it. When firſt taken out of the Earth it is ſoft and fattiſh; but ſoon after it grows ſomewhat hard. It is ſeldom found growing, but only ſticking to the Metal. The Miners call it *White Sparr*; and ſome of them think it is the Mother or Nouriſher of the Metal. But it is certain that *Sparr* is often met with in mooriſh Grounds, where they never hope to find any Ore: Yet no *Tin Mines* are without it.

The *Corniſh* Diamonds, ſo called, lie intermixed with the Ore, and ſometimes on Heaps. They are hard enough to cut Glaſs, and ſome of them are of a tranſparent red, and have the Luſtre of a deep Ruby. Theſe Diamonds, ſeem to me to be but a finer, purer, and harder ſort of *Sparr*.

Godolphin Ball is the moſt famous of all the Balls or Mines in *Cornwal*, for the Quantity of Metal. Though ſome of late Years pretend another Mine (which ſome call the *Silver-Mine*, others the *Lead-Mine*) more rich than that. I have ſeen an Eſſay made of ſome of that Ore, as it was ſaid, brought from thence; whereof 10 Pound weight yielded 2 ¼ Ounces of fine Silver.

The beſt Ore is that which is in Sparks; and next to this, that which hath bright *Sparr* in it.

When the Ore has paſſed the Stamping-mill, and is well waſhed and ſeparated from the parts not metalline (which they call the Cauſalty) they dry it in a Furnace on Iron Plates, and then grind it very fine in a Crazing-Mill. After this they rewaſh it, then dry it a little, and carry it laſt of all thus fitted to the Furnace, called by them a Blowing-Houſe, and there melt and caſt it.

There ſwims on the Metal, when it runs out of the Furnace, a Scum which they call Droſs; much like to Slag or Droſs of Iron; which being melted down with freſh Ore, runneth into Metal.

The Cauſalty they throw in Heaps upon Banks, which in ſix or ſeven Years they fetch over again: But they obſerve that in leſs time it will not afford Metal worth the Pains; and at the preſent none at all.

Lead Mines *in* Somerſetſhire; *By Mr.* Joſ. Glanvil, *n.* 28. *p.* 525.

CIV. 1. I am well informed, that all *Mendip* in *Somerſetſhire* is mountainous: Yet the Hills not equal in height. It is barren and cold, and rocky in ſome Places. The Ridges thereof run confuſedly, but moſt Eaſt and Weſt, and not in any parallel one with another. Upon the Surface thereof, it is heathy, ferny, and furzy; and the Cattle it feeds, for the moſt part, are Sheep, which go there all the Year; and young Beaſts, Horſes and Colts, at Spring and Fall. The Sheep are not fair, but big-bellied, and will grow to no bigneſs, after they have been there fed; but will grow fat, if they are removed into better Soil; and ſo their Beaſts and Horſes.

The Inhabitants live healthy, ſaving ſuch as are employed about melting of the *Lead* at the Mines; who, if they work in the Smoak, are ſubject to a Diſeaſe, that will kill them, and the Cattle likewiſe that feed thereabout. The Smoak that reſts upon the Ground will bane them: And therefore

fore the Inhabitants have Keepers to keep them from it, for fear of the Infection. At the Foot of the Hills there are many Springs which are very wholſome; and produce Rivers, after they have run to ſome diſtance from thence. The Air is moiſt, cold, foggy, thick and heavy.

The Soil is red and ſtony; and the Stones are either of the Nature of Fire-ſtones or Lime-ſtones, but no way clayie, marly, or chalky. The Trees have their Tops burnt, and their Leaves and out-ſides diſcoloured, and ſcorched with the Wind, and grow to no Bigneſs. The Stones that are waſhed by the Brooks and Springs, are of a reddiſh Colour, and ponderous. Snow, Froſt, and Dew, ſtay upon *Mendip* longer than upon any of the neighbouring Grounds. Thunder and Lightning, Storms, Nocturnal Lights, and Fiery Meteors, are more frequent than ordinary.

When they have got the Ore they beat it ſmall, then waſh it clean in a running Stream; then ſift it in Iron Rudders; then they make a Clay, or Fire-ſtone, an Hearth, or Furnace which they ſet in the Ground, and upon it build their Fire, which is lighted with Charcoal, and continued with young Oaken *Gadds*, blown with Bellows by Mens treading on them: And after the Fire is lighted, and the Fire Place hot, they throw their Lead Ore upon the Wood, which melts down into the Furnace; and then with an Iron-Ladle they take it out, and upon Sand caſt it into what Form they pleaſe.

A further Account by Mr. Glanvil, *n.* 39. *p.* 767.

2. I am farther informed, by experienced Mine Men, that they have ſometimes known the Veins to run up into the Roots of Trees, and yet they have obſerved no difference at the Top, with reſpect to the other Trees there, into whoſe Roots no ſuch Veins run. The Snow and Froſt near the Grooves melt quickly, but continue long at further diſtance. Sometimes when a Mine hath been very near the Surface, the Graſs hath been yellow and diſcoloured. They have no value for *Virgula Divinatoria*; yet they ſay when the Mine is open, they may gueſs by it how far the Vein leads. White, yellow, and mixt Earth are Leaders to the Country (as they call it:) Changeable Colours always incourage their Hopes. For Stones, they are ſometimes 12 Fathom deep, before they meet any: Other while, when a Stony-Reak at top, they meet Ore juſt under the Swerd [Superficies] of the Graſs, which Ore hath gone down about 40 Fathom. A black Stone is of bad Signification, and leads to a *Jam* [a black thick Stone, that hinders their Work:] A grey clear dry one they account beſt. They ſeldom encounter Damps. If in ſinking they come to wet mooriſh Earth, they expect a *Jam*, and to be cloſed up with Rocks. The nearneſs they gueſs by ſhort brittle Clay; for the tough is not leading.

The Ore ſometimes is Shole, and again it is 14 or 20 Fathom, more or leſs before they hit it. They follow a Vein inclining to ſome depth, when it runs away in flat Binns.

When the Stones part it, then they find a Vein again. Their Draughts are 14 or 16 Fathom, till they come to a Stone, where they caſt aſide a Draught called a Cut: Then they ſink plum again four or five Cuts, one under another. They find Ore at 50 Fathom. Their beſt Reaks are North and

South; Eaſt and Weſt are good, tho' not ſo deep. The Groove is Four Foot long. 2½ Foot broad, till they meet a Stone, when they carry it as they can. The Groove is ſupported by Timber: A piece of an Arm's bigneſs will ſupport 10 Tun of Earth. It laſts long; that which was put in beyond the Memory of Man (nay which by the difference in the manner of working their Mines, they know to have lain above 200 Years) will ſerve in new Works. It is tough and black, and being expoſed to the Sun and Wind for two or three Days, will ſcarce yield to an Ax.

For the Supply of Air they have Boxes of Elm exactly cloſed, of about ſix Inches in the Clear, by which they carry it down above 20 Fathom. But when they come at Ore and need an *Air-ſhaft*, they ſink it four or five Fathom diſtant, of the ſame Faſhion with a Groove, to draw as well Ore, as Air.

They make uſe of Leathern Bags, of eight or nine Gallons apiece, drawn up by Ropes, to free the Water. If they find a *Swallet*, they drive an Adit, upon a Level, till 'tis dry.

If they cannot cut the Rock, they uſe Fire to anneal it, laying on Wood and Coal, and the Fire ſo contriv'd, that they leave the Mine before Operation begins, and find it dangerous to enter again, before it be quite clear'd of the Smoak; which hath killed ſome.

Their Beetles, Axes, Wedges, *&c.* unleſs ſo hardned as to make a deep Impreſſion upon the Head of an Anvil, are not fit for their Uſe; and yet they ſometimes break them in an Hour; others laſt three or four Days, as it happens. They work clothed in Frocks and Waiſt-Coats, by Candle-Light of Tallow, 14 or 15 to the Pound, each whereof laſt three Hours, if they have Air enough; which if they want to keep in the Candles, the Workmen cannot ſtay there. A Vein being loſt, they drive two or three Fathoms in the Breaſt, as the nature of the Earth directs them. They convey out their Materials in Elm-Buckets drawn by Ropes: The Buckets hold about a Gallon. Their Ladders are of Ropes.

The Ore runs ſometimes in a Vein, ſometimes diſperſed in Banks. It lies many times between Rocks: Some of it is hard, ſome milder. Many times they have branched Ore in the Spar. About the Ore there is Spar and Chalk, and another Subſtance, which they call the *Crootes*, which is a mealy white Stone, marted with Ore, and ſoft. The Spar is white, tranſparent, and brittle like Glaſs. The Chalk white and heavy; heavier than any Stone. The Vein lies between the *Coats*, and is of different Breadths. It breaks off ſometimes abruptly in an Earth, they call a *Deading Bed*, and after a Fathom or two may come again, keeping the ſame Point. It terminates ſometimes in a dead Earth, clayie, without Croot or Spar; ſometimes in a Rock call'd a *Fore-ſtone*.

The cleareſt and heavieſt Ore is the beſt; 36 hundred of Ore may yield a Tun of Lead.

The Hearth for melting the Ore is about 5 Foot high, ſet upon Timber, to be turned as a Wind-mill, to avoid the Inconveniences of Smoak upon a ſhifting Wind. It contains half a Buſhel of Ore and Coal. There is a ſink upon the ſides of the Hearth, into which the Lead runs, that holds about 1½ Hundred. They have a Bar to ſtir the Fire; a Shovel to throw it up; and a Ladle heated red hot to caſt out the melted Metal. Once melting is enough; and the beſt (which is diſtinguiſhed by its Weight) melts firſt.

There is a Flight in the Smoak, which falling upon the Graſs, poiſons thoſe Cattle that eat of it. They find the Taſte of it upon their Lips to be ſweet. And when the Smoak chances to fly in their Faces, brought home and laid in their Houſes, it kills Rats and Mice. If this Flight mix with the Water, in which the Ore is waſhed, and be carried away into a Stream, it hath poiſoned ſuch Cattle as have drunk of it after a Current of three Miles. What of this Flight falls upon the Sand, they gather up to melt upon a Flag Hearth, and make Shot and Sheet Lead of it.

They ſometimes find Slags, three, four, or five Foot under Ground; but ſuch as they judge were caſt aſide heretofore.

They have ſometimes heard Knockings beyond their own Works, which when followed by them, have afforded Plenty of Ore. And one *King* of *Wells* about two Years ſince found in his Groove a Piece of Ore, in which they fancied the ſhape of a Man, Eyes, Arms, Legs, full Breaſt, *&c.* The whole was about four Inches in length; the Mine proved rich.

In Germany; By . . . . n. 1. p. 10.

9. There is a peculiar Lead Ore found in the *Upper Palatinate*, at a Place called *Freyung*; and there are two ſorts of it, whereof one is a kind of Chryſtalline Stone, and almoſt all good Lead; the other not ſo rich, and more Farinaceous. The Mines of that Place having lain long neglected, the People living thereabout take it for what their Fathers had thrown away, and had lain long in the open Air. It is of ſingular Uſe for Eſſays upon the Coppel, ſeeing that there is not any other Metal mixed with it.

The poiſonous Quality of Lead Ore; By Mr. J. Beaumont, Ph. Col. n. 1. p. 6.

CV. Thoſe who live near where Lead Ore is waſhed, cannot keep either Dog or Cat, or any ſort of Fowl, but they all die in a ſhort time; and I have known of a little Houſe wherein Lead Ore was kept ſome time, tho' afterward made very clean and well bedded with Fern, yet when Calves were put into it, they all died ſhortly after; and Children ſometimes, in theſe Houſes, have died ſuddenly. If any ſort of Cattle eat often of that Graſs, on which the Steam, which riſes from the Smelting of Lead, falls, they all die in a while after.

The Way of making of Ceruſs; By Sir Philiberto Vernati. n. 137. p. 935.

CVI. Pigs of clean and ſoft Lead are caſt into thin Plates, a Yard long, and ſix Inches broad. Theſe are rolled round, ſo that the Surfaces no where meet to touch: For where they do, no *Ceruſs* grows. Each of theſe is put into a Pot, juſt capable to hold one, upheld by a little Bar from the bottom, that it come not to touch the Vinegar, which is put into each Pot, to effect the Converſion. Twenty of theſe abreaſt, are put into a ſquare Bed of new Horſe-Dung; and each Pot is covered with a Plate of Lead; and laſtly, all with Boards, as cloſe as conveniently can be. This repeated four times makes one Heap, ſo called, containing 1600 Pots.

After three Weeks the Pots are taken up, the Plate unrolled, laid upon a Board, and beaten with Battledores till all the Flakes come off; which, if good, prove thick, hard and weighty. Theſe Flakes are ground with Water, between Mill-ſtones, to almoſt an impalpable Fineneſs. After which it is moulded into ſmaller Parcels, and expoſed to the Sun to dry, till it be hard, and ſo fit for Uſe.

It is obſerved, that ſome Pots will yield thick and good Flakes, whilſt others alike ordered and ſet by them without any poſſible Diſtinction of Advantage, yield few and ſmall, or none at all. Sometimes the Poles are taken up all dry, and ſo ſometimes prove beſt; ſometimes again they are taken up wet. The Plates that cover the Pots yield better and thicker Flakes, than do the Rolls within. And the outſides, next to the Planks, bigger and better than the inſides, next to the Rolls, and the Spirits that firſt ariſe out of the Vinegar.

The Accidents which happen to the Workmen, are, 1. Immediate Pain in the Stomach, with exceeding Contortions in the Guts, and Coſtiveneſs that yields not to Catharticks, hardly to often-repeated Clyſters; beſt to Lenitives, Oil of Olives, or ſtrong new Wort. It brings them alſo to acute *Fevers*, and great *Aſthma's* or ſhortneſs of Breath. And theſe we find effected principally by the Mineral Steams in the caſting of the Plates of *Lead*, and by the Duſt of the Flakes: Alſo by the Steams coming from out of the Heaps, when the Pots are taken up.

Next a *Vertigo*, or Dizzineſs in the Head, with continual great Pain in the Brows, Blindneſs, Stupidity, and Paralytick Affections; loſs of Appetite, Sickneſs, and frequent Vomitings, generally of mere Phlegm, ſometimes mixed with Choler, to the extreameſt Weakneſs of the Body; and theſe chiefly in them that have the Charge of grinding, and over the drying Place.

The Quick-ſilver Mines in Friuli; *By Dr.* Walt. Pope, *n.* 2. *p.* 21.

CVII. 1. The Mines of Mercury in *Friuli*, a Territory belonging to the *Venetians*, are about a Day's Journey and an half diſtant from *Goritia* Northwards, at a Place called *Idria*, ſituated on a Valley on the *Julian Alps*. They have been, as I am informed, theſe 160 Years in the Poſſeſſion of the Emperor, and all the Inhabitants ſpeak the *Sclavonian* Tongue. In going thither we travelled ſeveral Hours in the beſt Woods I ever ſaw; being very full of Firs, Oaks, and Beeches of an extraordinary Thickneſs, Straitneſs and Height. The Town is built as uſually Towns in the *Alps* are, all of Wood, the Church only excepted, and another Houſe wherein the Overſeer liveth. When I was there in *Auguſt* 1664, the Valley and the Mountains too, out of which the Mercury was dug, were of as pleaſant a *Verdure*, as if it had been in the midſt of Spring, which they there attribute to the Moiſtneſs of the Mercury. That Mine which we went into, the beſt and greateſt of them all, was dedicated to St. *Barbara*, as the other Mines are to other Saints. The uſual Way down to it is at the beginning not difficult, the Deſcent not being much; the greateſt Trouble is, that in ſeveral Places you cannot ſtand upright; but this holds not long, before you come to deſcend in earneſt by perpendicular Ladders; yet when produced, they do not ſeem to make one Ladder, but ſeveral parallel ones. at the End of each Ladder, there are Boards acroſs where we may breathe a little. All the way down, and the Bottom, where there are ſeveral Lanes cut out in the Mountain, is lined and propt with great Pieces of Fir-Trees as thick as they can be ſet. They dig the Mineral with Pick-Axes, following the Veins: It is for the moſt part hard as a Stone, but more weighty; of a Liver-Colour, or that of *Crocus Metallorum*. There is alſo ſome ſoft Earth in which you plainly ſee the *Mercury* in little Particles. Beſides this, there are oftentimes found in the Mines round Stones like Flints, of ſeveral Bigneſſes, very like thoſe Globes of Hair which I have ſeen in *England* taken out of an Ox's Belly. There are alſo ſeveral Marcaſites and Stones, which ſeem to have Specks of Gold in them; but upon Trial, they ſay, they find none in them. Theſe round Stones are ſome of them very ponderous, and well impregnated with *Mercury*; others light, having little or none in them.

The manner of getting the *Mercury* is this: They take of the Earth, brought up in Buckets, and put it into a Sieve, whoſe Bottom is made of Wires at ſo great a diſtance, that you may put your Finger between them; it is carried to a Stream of running Water, and waſhed as long as any thing will paſs through the Sieve. That Earth which paſſeth not, is laid aſide upon an Heap; that which paſſeth, is reſerved in a Hole, and is taken up again, and put into a ſecond Sieve: and ſo on to about 10 or 12 Sieves proportionably leſs. It often happens in the firſt Hole, that there is *Mercury* at the Bottom; but towards the farther End, where the Intervals of the Wire are leſs, it is found in very great Proportion. The waſte Water is ſo much impregnated with *Mercury*, that it cureth *Itches* and other ſordid *Ulcers*. The Earth laid aſide, is pounded, and the ſame Operation repeated. The fine ſmall Earth that remains after this, and out of which they can waſh no more *Mercury*, is put into Iron Retorts, and the Fire forces the *Mercury* into the Receivers: The Officer unluted ſeveral of them; and I obſerved in all that he firſt poured out perfect *Mercury*, and after that came a black Duſt, which being wetted with Water, diſcovered itſelf to be *Mercury* as the other was. They take the *Caput Mortuum* and pound it, and renew the Operation. There are 16 Furnaces for this Uſe, each of them carrying 24 Retorts; in all 384 Retorts.

All the *Mercury* got without the uſe of Fire, whether by waſhing or found in the Mines (for in the digging ſome, the Particles get together, ſo that in ſome Places you might take up two or three Spoonfuls of pure *Mercury*) is called by them *Virgin Mercury*, and eſteemed above the reſt. The Officer told me, that making an *Amalgama* of *Gold* and *Virgin Mercury*, and putting it to the Fire, that *Mercury* would carry away all the *Gold* with it, which common *Mercury* would not do.

The Engines for drawing the Water, are all moved by Water, brought, thither in no chargeable Aqueduct from a Mountain three Miles diſtant. The Water pumped from the Bottom of the Mine, by 52 Pumps, 26 on a Side, is contrived to move other Wheels, for ſeveral other Purpoſes.

The Labourers (being 280 always employed) work for a *Julio* a Day, which is not above 6 or ſeven Pence, and endure not long: for although none ſtay under ground above 6 Hours; all of them in time (ſome later, ſome ſooner) become Paralytick, and die Hectick. We ſaw a Man who had not been in the Mines for above half a Year before, ſo full of Mercury, that putting a piece of Braſs in his Mouth, or rubbing it in his Fingers, it immediately became as white, as if he had rubbed *Mercury* upon it. Thoſe alſo that work upon the Back-ſide of Looking-glaſſes, are very ſubject to the Palſey.

They convey their Woods thus: Above four Miles from the Mines on the ſides of two Mountains, they cut down the Trees, and draw them into the interjacent Valley: higher up in the ſame Valley they make a Lock or Dam; when the Water is ready to run over it, they open the Flood-Gates, and the Water carries all the Trees impetuouſly to *Idria*, where the Bridge is built very ſtrong, and at very oblique Angles to the Stream, on purpoſe to ſtop them, and throw them on ſhore near the Mines.

Thoſe Mines heretofore coſt the Emperor 70000 or 80000 Florins yearly; but now they coſt him not above 28000. They produced

	Anno 1661.	*Anno* 1662.	*Anno* 1663.
	l.	*l.*	*l.*
Ordinary Mercury,	198481	225066	244119
Virgin Mercury,	6194	9612	11862
In all	204675	234678	255981

By Dr. Edw. Brown, n. 54. p. 1018.

2. The Town *Idria* in the Country of *Goritia* and Province of *Friuli*, is ſeated low, and encompaſſed with Hills on all ſides. A River of the ſame Name runs by it, and proves ſufficient upon plentiful Rains to convey down the Fir-Trees and other Wood required in the ſervice of the Mines: And to this end there is an handſome Work of Piles made ſloping athwart the River (after the ſame manner as I obſerved in *Newſol* in *Upper Hungary*, croſs the River *Gran*) to ſtop the Trees.

The Entrance into theſe Mines is not high, or upon a Hill, but in that Town itſelf. The deepeſt part of the Mine from the Entrance, is between 120 and 130 Fathoms.

The *Virgin Quickſilver*, which they call *Jungfraw*, is that which diſcovers itſelf without the help of Fire. Sometimes it is plainly ſeen in the Ore, or falls down in Drops, and ſometimes ſtreams out in good quantity; as about 7 Years ago it ran out of the Earth at firſt in a Stream as ſmall as a Thread, and afterwards as big as a Packthread, but ceaſed in 3 or 4 Days. That alſo is accounted *Virgin Quickſilver*, which is ſeparated only by Water.

Plain Quickſilver they obtain by Fire out of the Ore, or out of the *Cinnabar* of Mercury, which they dig out of this Mine. The Ore of this Mine is of a dark Colour, mixed with Red.

The *Quickſilver* Ore of this Mine ordinarily contains half, and ſometimes two-thirds of *Quickſilver*.

I went into the Mine by the Pit of St. *Agatha*, and came up again by that of St. *Barbary*, deſcending and aſcending by Ladders. I aſcended at one of 639 Staves, or 89 Fathoms, It has been wrought 200 Years, about the ſame Space of time with *Newſol* Mine, but comes much ſhort in time of the Silver Mine at *Schemnitz*; and much ſhorter yet of the notable Lead Mines in *Upper Carinthia*.

In a *Laboratory*, where the *Quickſilver* is ſeparated by Fire, I ſaw an heap of 16000 Retorts of Iron; every one of which coſts a Crown at the beſt hand from the Iron Furnaces in *Carinthia*. There are 800 Retorts and as many Recipients, employed together, in drawing over the *Quickſilver* in 16 Furnaces; 50 in each Furnace, 25 of a ſide; 12 above, and 13 below of each ſide.

June 12, 1669. When I was there, they carried out 40 Saumes of *Quickſilver* into Foreign Parts, each Saume containing 315 pound Weight, to the value of 4000 *Ducats* of Gold. Some of it is ſent as far as *Cremnitz* in *Hungary*, for the uſe of the Gold Mines: And very much carried away Southward; for they are not far from the *Sontius*, or *Lyſonzo*, a conſiderable River, which runs into the Gulph of *Trieſte* in the *Adriatick Sea*.

In the Caſtle, I ſaw 3000 Saumes of *Quickſilver* together in Barrels; the *Quickſilver* being firſt made up in double Leather: And in another Houſe as much Ore as can be diſtilled in two Years, except they have great Plenty of Rain to bring down the Wood.

The Country is well ſtored with ſtately Firs, Larches, Pines, Pinaſters, Picea's, and that noble criſped and well grained kind of Acer, whereof Viols and Violins are made: Whereof there is alſo Plenty in the Country of *Saltzburg* and *Carniola*.

Travelling ſometimes in the Night, we had continually about us a great Number of large Glow-worms, which put into Papers, give a dim Light like Candles in Lanthorns; and the Air alſo was full of Flaming Flies, affording ſome delight unto us.

The way to this Place from *Croatia* I found difficult; and coming from it to *Aidoſchini* and *Croatia*, I paſſed over *Swartzenburg*, or the Black Mountain, from whence I deſcended 10 miles in a Rocky Country, and far more Stony than the Craw, or *Campus lapidoſus*, in *Provence*.

CVIII. In the Valley of *Lancy*, which runs between the Mountains of *Turin*, grows a Plant like the *Doronicum*, (ſo alſo called by the Inhabitants and *Botaniſts*;) near the Roots whereof you may find pure *Quickſilver*, running in ſmall Grains like Pearls; the Juice of which Plant being expreſſed and expoſed to the Air of a clear Night, there will be found as much *Mercury*, as there is loſt of Juice.

Mercury found in Plants; By S. Manfred Septalius, *n.* 27. *p.* 493.

CIX. Tho' I have many things to object againſt the Sympathy of *Gold* with *Quickſilver*; yet perhaps there may be *Quickſilver* more ſubtle and ponderant

The Incaleſcence of Mercury with Gold; By B. R. *n.* 122. *p.* 515.

ponderant than that which is common, which may enable the Chymiſt to argue very ſpeciouſly for it.

It is hotly diſputed among the Curious in *Chymiſtry*, whether or no there be any ſuch thing as a Mercury, which being barely mingled with Gold, reduced to fine Parts, will produce any ſenſible Heat. The Affirmative is aſſerted by ſome that pretend to the Tranſmutation of Metals, who aſcribe this Virtue to the Mercuries, extracted, as they ſuppoſe, from ſome compleat Metals; which are therefore, in their Phraſe, ſtiled *Mercurii Corporum*, or the Mercuries of metalline Bodies. But the Negative is more generally maintained, not only by Philoſophers and Phyſicians, but the more learned *Spagyriſts* themſelves, eſpecially the Modern.

I the leſs wonder at this latter Opinion, becauſe having purpoſely enquired of ſeveral prying *Alchymiſts*, they have apart ingeniouſly confeſſed to me, that they never actually ſaw any incaleſcent Mercury, though they had ſometimes heard it boaſted of.

But notwithſtanding all this, having for ſeveral Reaſons looked upon Mercury as a Body which is not neceſſarily ſo homogeneous as it is ſuppoſed, the Opinion I moſt liked of was, that of a Poſſibility of an incaleſcent Mercury. For notwithſtanding the vulgarly ſuppoſed ſimilar Nature of Quickſilver, which I willingly confeſs to be great enough to be admirable; yet having deviſed two Ways (unpractiſed that I know of by any *Chymiſt*) the one to diſcover whether a clean and careful diſtilled Mercury might not be a compounded Body, and have in it Parts that are not mercurial; and the other out of ſuch a fine diſtilled Mercury to ſeparate Parts, and that in no deſpicable Number, that are plainly heterogeneous: I found upon Trial, that both the Methods I had thought on would ſucceed; which warranted me to think it poſſible, that a Mercury very fine and clean, and even purged by Sublimations and Diſtillations, may, by Art, have been made to aſſume and incorporate with it a Multitude of heterogeneous Corpuſcles, not to be diſcovered, much leſs ſeparated (as thoſe of *Tin*, *Lead*, &c. may be) by a ſkilful Artiſt.

This was enough to ingage me to make Trials, whether ſome of theſe heterogeneous Particles, that I found reducible with *Mercury* into a laſting mercurial Flux, might not ſo alter it, as to diſpoſe it to heat with Gold: And that there were ſuch, through God's Bleſſing, my Trials afforded me poſitive Proof, about the Year 1652.

But when I was alone, that I might not be impoſed upon by others, I took to one Part of our *Mercury* ſometimes half the Weight, and ſometimes an equal Weight of refined *Gold* reduced to *Calx*, or ſubtle Powder. This I put into the Palm of my Left Hand, and putting the *Mercury* upon it, ſtirred it, and preſſed it a little with the Fingers of my Right Hand, by which the two Ingredients were eaſily mingled, and grew not only ſenſibly but conſiderably hot, and that ſo nimbly, that the Incaleſcence did ſometimes come to its height in about a Minute of an Hour, by a Minute Clock. I found the Experiment ſucceed, whether I took all together, or but half as much Gold as *Mercury*; but the Effect ſeemed to be much greater when they were employed in equal Weight.

I tried alſo the ſame *Mercury* with *refined Silver*, reduced to a very fine Powder; but I could not perceive any Heat or Warmth at all, though I am apt to think, with a ſufficient Quantity of *Leaf Silver*, it might have been ſenſible.

I made Trial afterwards oftner than once, in the Hands of others, who were not a little ſurprized and pleaſed at the Event; particularly having given the Ingredients to the learned Secretary of the *Royal Society*, I deſired him to make the Experiment in and with his own Hand, in which it proved ſucceſsful within ſomewhat leſs than a Minute of an Hour. (And the Lord Viſcount *Browncker*, Preſident of the *Royal Society* made the ſame Experiment with ſome of the ſame *Mercury*, in his own Hand, with good Succeſs.)

This Incaleſcence was the more conſiderable, ſince being willing to huſband my *Mercury*, I made theſe Trials but with a Drachm at a time, which ſcarce amounts in quantity to the Bigneſs of half a middle-ſized Bean; and yet I have ſometimes had of this *Mercury* ſo ſubtle, that the Heat made me willing to put it haſtily out of my Hand.

However, I will not hence determine, whether thoſe that are *Mercurii Corporum*, and were made, as *Chymiſts* preſume, by Extraction only from Metals and Minerals, will each of them grow hot with Gold, as, if I much miſtake not, I found *Antimonial Mercury* to do. Nor will I affirm, that ever *metalline Mercury*, tho' ever ſo diſpoſed to Incaleſcence, or even that of *Silver* and *Gold* it ſelf, is the ſame with that which the *Chryſopean* Writers mean by their *Philoſophick Mercury*, or is near ſo noble as this. Nay, I will not ſo much as affirm, that every *Mercury*, obtained by Extraction, even from the perfect Metals themſelves, muſt needs be more noble and fit, as *Alchymiſts* ſpeak, for the *Philoſophick Work*, than that which may with Skill and Pains be at length obtained from *Common Mercury*, ſkilfully freed from its recrementitious and heterogeneous Parts, and richly impregnated with the ſubtle and active ones of congruous Metals or Minerals. But if there be any truth in what ſome of the moſt approved *Spagyriſts* have delivered about a Solvent of Gold, that ſeems of kin, and perhaps is not much nobler than one that I had, it ſeems allowable to expect, that even ours ſhould be of more than ordinary Uſe, both in *Phyſick* and *Alchymy*.

I had almoſt forgot to tell you, that whereas 'tis uſual to take 4, 5, or 6, nay 8 or 10 parts of *common Quickſilver*, to make an *Amalgama* with one of Gold, even when both are heated by the Fire; I found our *Mercury* ſo congruous to that Metal, that it would preſently imbody with no leſs than an equal Weight of it, and produce a pretty hard *Amalgama* or Mixture, in which the *Mercury* was ſo diffuſed, that the Gold had quite loſt its Colour. *Secondly*, I ſhall add, what for ought I know has not been yet obſerved, that this Power of penetrating Gold, and growing hot with it, is ſo inherent, not to ſay radicated, in our *Mercury*, that after it had been diſtilled from Gold again and again, I found it to retain that Property. And *Laſtly*, I found by Trial, that a ſingle Drachm of *Mercury*, made after a certain manner, did the 3d or 4th Year after I had laid it by, grow ſo hot with Gold, that I feared it would have burnt my Hand.

It may be doubted whether the good that the Preparations of it (ſuch as Precipitates and Turbiths of divers kinds, *Mercurius dulcis*, *Cinnabar* made of the Sulphur of Antimony, and with Gold, *&c.*) may do in Phyſick, is likely much to exceed the political Inconveniencies that may enſue, if it ſhould prove to be of the beſt Kind, and fall into ill Hands. The knowledge of the Opinions of the wiſe and ſkilful about this Caſe, will be requiſite to aſſiſt me to take right meaſures in an Affair of this nature. And till I receive this Information, I am obliged to ſilence. In the mean while, I ſhall make bold to add this Secret, which to ſome I think will ſeem a Paradox, namely, That a Mercury qualified to heat with Gold, and perhaps with other Powders, may be made by more Ways than one or two; Experience having aſſured me that ſuch a Mercury may be prepared, not only by employing Antimony and ſolid Metals, as *Mars*, but without any ſuch Metal at all, or ſo much as Antimony itſelf.

I ſhall only admoniſh thoſe inquiſitive *Spagyriſts*, that may be deſirous to try, whether their purify'd Mercury be incaleſcent, that they be not too haſty to conclude it is not ſo, nor to reject it, unleſs they have made the Trial with Gold duly prepared. For the ſmalleſt filings of Gold I could make, or even ſome Calxes of Gold, will not ſerve our turn, as I have found by employing, without Succeſs, a very fine and ſpongy Calx, made after an uncommon way; the golden Particles having, as it ſeemed, ſome extremely fine tho' unobſerved Duſt of the Additament ſticking to them, which hindred the Adheſion of the mercurial ones. Now the Calx of Gold that I moſt uſed, as finding it ſtill to do well, was that made by Quartation, as *Alchymiſts* call it, that is, by melting together one part of fine Gold, and 3 or 4 parts of cuppelled Silver, and then putting the Maſs, wherein the Metals are mixed almoſt *per minima*, into purify'd *Aquafortis*, which diſſolving the Silver only, leaves the Gold in the form of a fine Calx. Alſo, by making an Amalgama with pure Gold and vulgar Mercury, and diſſolving the Mercury in good *Aquafortis*, there will remain a Powder, which being well waſhed in fair Water, to dulcify it and keep a while in moderate Fire, to dry it thoroughly without melting it, will become a Calx, which I have more than once uſed with our Mercury with good Succeſs. I have alſo ſometimes taken, inſtead of a Calx of Gold, a competent number of Leaves of Gold, reducing by beating only, without the help of Salts, to ſufficient thinneſs, inſomuch that between 70 and 80 Leaves did not weigh a Scruple: and putting 2 or 3 times the Weight of our Mercury to them, I have found, more than once, that a ſmart Heat was preſently produced in my Hand.

The Silver Mines in Hungary, *by Dr.* Edward Brown, *n.* 58. *p.* 1196.

CX. There are divers Silver Mines at *Schemnintz* in *Hungary*; but the chiefeſt and moſt wrought, are thoſe of *Windſchacht* and *Trinity*.

They have no River here, tho' much Water in the Mines, ſo as they are conſtrained to ſend much of their Ore to *Hodritz* and other places, where are ſmall Rivers, by which their Bellows and Hammers may be moved, (their

Ore pounded, waſhed, and other Works requiſite, performed. To draw about the Engines to pump out the Water, 12 Horſes at a time are employed to each Wheel: But in *Windſchacht* Mine, deep in the Earth, is a large Wheel of 12 Yards Diameter, turned about by the Fall of ſubterraneous Water; which, together with the other Water, pumped from the deepeſt Parts of the Mine, runs thro' a Cuniculus made on purpoſe, at the Foot of the Hill.

Trinity Mine is 70 Fathom deep, built and kept open with under-work at a great Expence. Much of this Mine being in earthly Soil, the Ore of it is much eſteemed. Divers Veins lie North; and other rich Veins run to the North-Eaſt. When two Veins croſs one another, they eſteem it fortunate. They uſe not the *Virgula divina*, and have no certain way to know either which way the Veins run, or where they are, till by the induſtrious perſevering in the Labour of the Mines, they are at laſt found out. They ſhewed me one Place, which they had digged ſtrait on 6 Years, when the Ore was but two Fathoms diſtant from the Place where they began; and in another Place they digged 12 Years outright, and at laſt found a Vein, which in a ſhort time payed their Charges.

The blackiſh Silver Ore is eſteemed the beſt; much of it hath a Mixture of a ſhining yellow Subſtance or Marcaſite, which if it be not in too great a Quantity, is not unwelcome; by reaſon that it diſpoſeth the Ore to Fluidity, or renders it more eaſy to be melted: But if it be in too great a Porportion, they are of Opinion, that it preys upon the Silver in the Mine, and in the Furnace carrieth it away while it melteth, by over volatizing it.

There is often found a red Subſtance, which grows to the Ore, called *Cinnabar*, *Cinnabar* of *Silver*, *Cinnabaris nativa*, *Minium nativum*, or *Berg-Cinnabar*. This Subſtance grinded with Oil, maketh a Vermilion, equal to, if not ſurpaſſing the Cinnabar made by Sublimation. I diſcovered a Sulphur in it, by caſting it upon a hot Iron-Plate, on which it burned blue. The Miners ſay, they meet not with any Quickſilver, but they find Chryſtals, Amethiſts, or Ametheſtine mixtures, in the Clefts of the Rock, and ſometimes nigh, or joined to the Ore, as alſo Vitriol naturally chryſtallized in the Earth, in divers of the Mines, and particularly in a Mine in *Paradiſe-Hill*, near *Schemnitz*.

An hundred Pound Weight of Ore ſometimes yields but half an Ounce, or an Ounce of Silver; ſometimes 2 Ounces, 3, 4, 5, and unto 20 Ounces. What is richer is very rare, yet ſome hath been found to hold half Silver; and I have ſeen it ſo rich, as to be cut with a Knife.

A Specimen of each ſort of Ore, which they dig out of the Mines, is carried to an Officer called the *Probierer*, who is to prove and judge of its Richneſs, which he doth in this manner. Of all ſorts of Ores he taketh the ſame Quantity. The Ores being firſt dried, burnt and powdered, he giveth an equal Proportion of Lead to all, melteth and purifieth them; then by exact Scales, takes notice of the Proportion between the Ore and the Metal contained in it; and reports it to thoſe employed in the great melting Furnaces.

If

If the Ore be found to hold 2½ Ounces or more of Silver in 100 Pound weight, they ordinarily melt it without any foregoing Preparation, by the Help of Iron Stone (which is not Iron Ore, but a Stone found thereabout, of which the Liver-coloured is the beſt) *Kys* (a ſort of *Pyrites*) and *Slacken* (a Scum or Cake taken off from the top of the Pan, into which the melted Mineral runs, and is a Subſtance made out of the former mentioned by Fuſion ;) which are thrown in with it into the melting Furnace.

If the Ore be poorer, holding but two Ounces in 100 Pound weight, or leſs, it is firſt pounded and waſhed, till it becomes richer, or hath a greater Proportion of Metal in reſpect of the Ore, much of the Earthy Parts being waſhed away. Then it is thrown into the Furnace with the former Materials ; and the *Marchaſite*, which remains ſtill with it, as ſinking always to the bottom with the Silver in the Waſh-works, helps to the quicker Fuſion of the Ore.

Whatſoever is melted in the melting Furnace, is let out through a Hole at the bottom thereof, into the Pan which is placed in the Earth before it ; and, thus expoſed, it immediately acquires a hard Scum, Droſs, Loaf, or Cake ; which being oft taken off from the top, the Metal remaining in it becomes purer ; to which is added Lead, and after ſome time the melted Metal is taken out. Then being again melted in the driving Furnace, the Lead, or what elſe remains mixed with the Silver, is driven off by the blowing two great Bellows, and runs over in the Form of Litharge. That which firſt comes over is the white, and that which is laſt, being longer in the Fire, is the red ; not that it is Litharge of Gold ; both being driven off from the ſame Metal.

Moſt of the *Schemnitz* Silver Ore holds ſome Gold, which they ſeparate by melting the Silver, then granulating it, and afterwards by diſſolving it in *Aqua fortis*, whereby the Gold is left at the bottom, and is afterwards melted. The *Aqua fortis* is diſtilled from the Silver, and ſerveth again for Uſe.

The Silver then ſeparated from all its former Aſſociates, is ſent to *Cremnitz*, where they coin it into Pieces of a mixed Metal (which is the common Money of the Country) after this manner : They melt it with about the ſame quantity of Copper, and run it into Bars, which they beat out ; then ſoftening them in the Fire, draw them out to an exact Thinneſs between two Steel Wheels ; then they cut them out into round Pieces with an Inſtrument like a Shoe-maker's Punch, and then boil them with Tartar and Salt, ſhake them in a Sack with Small-coal and Water, dry them in a Kettle perforated, and afterwards they are drawn between two Wheels, in which they receive their Stamp.

The Gold Mines in Hungary, *by Dr.* Edward Brown, *n.* 158. *p.* 1192.

CXI. Among the 7 Mine-Towns in *Hungary* (which are not far from one another, *viz. Chremnitz*, *Schemnitz*, *Newſol*, *Koningſberg*, *Bochantz*, *Libeten*, and *Tiln*) *Chremnitz* is the richeſt in Gold. They have alſo, at preſent, Gold Mines at *Bochantz* and *Koningſberg* ; and they report in that Country, that there hath been formerly a rich Gold Mine at *Glaſs-Hitten*, but loſt ſince that *Bethlem Gabor* over-run thoſe Parts, when the Undertakers ſtopp'd up the Mine and fled.

They have worked in the Gold Mine at *Chremnitz* 900 Years. This Mine is ſeveral *Engliſh* Miles in length, and about 160 Fathoms deep. Many Veins of the Ore run to the North, and to the Eaſt. They work alſo towards one, two, and three of the Clock, as they ſpeak; for the Miners direct themſelves under Ground by a Compaſs, not of 32 Points (ſuch as is uſed at Sea) but by one of 24; which they divide, as we do the Hours of the Day, into twice Twelve. Of the Gold Ore, ſome is white, and ſome black, red, or yellow: That with black Spots in white is eſteemed the beſt, as alſo the Ore which lieth next to the black Veins. This Ore is not rich enough to ſuffer any Proof in ſmall Parcels, like that in other Mines, whereby to know what proportion of Metal is contained in it; but they pound a very great Quantity thereof, and waſh it in a little River, which runs nigh the Town. The whole River being divided, and admitted into diverſe Cuts, runs over the Ore continually, and ſo waſheth away the earthy Parts from the metalline: And from a clear River above the Town, by its running thro' ſo many Works, and over ſo much pounded Ore, it becomes below the Town, a dark yellow Stream, of the Colour of the Earth of thoſe Hills.

There have been Pieces of pure Gold found in the Mine. Some of which I have ſeen in the Emperor's Treaſury, and in the Elector of *Saxony*'s Repoſitory; one piece as broad as the Palm of my Hand, and others leſs; and upon a white Stone many pieces of pure Gold: but theſe are very rare.

The common yellow Earth of the Country near *Chremnitz*, altho' it be not eſteemed Ore, affords ſome Gold: And in one Place I ſaw a great part of a Hill digged away, which hath been caſt into the Works, waſhed and wrought in the ſame manner as pounded Ore, with conſiderable Profit.

Some Paſſages in this Mine, cut thro' the Rock, and long diſuſed, have grown up again; and I obſerved the Sides of ſome, which had been formerly wide enough to carry their Ore thro', to approach each other, ſo as we paſſed with difficulty. This happens in moiſt Places. The Paſſages unite not from the top to the bottom, but from one Side to another.

There is *Vitriol* in this Mine, white, red, blue and green; and alſo *Vitriol* Waters. There is a Subſtance found, which ſticks to the Gold Ore, of ſmall pointed parts like Needles, called by them *Antimony of Gold*. There are Chryſtals found here, and ſome tinctured yellow.

The Miners will not allow any *Quick-ſilver* or *Brimſtone* to have been found here; yet in the lately mention'd *Antimony of Gold*, there is evidently *Sulphur*, as I perceived by burning. The *Quick-ſilver* Mine, mentioned in the Anſwer to *Kircher*'s Inquiries, *Mund. Subter.* is an *Hungarian* Mile, or ſeven *Engliſh* Miles diſtant from *Chremnitz*; and is not wrought in at preſent.

There is a *Vitriol* Mine in theſe Hills near the Gold Mine; the Earth or Ore of it is reddiſh, and ſometimes greeniſh. This Earth is infuſed in Water, and after 3 Days the Water is poured off, and boiled 7 Days in a Leaden Veſſel, till it come to a thick granulated whitiſh Subſtance, which is afterwards reduced to a Calx in an Oven, and ſerveth in the making *Aqua-fortis*, or the ſeparating Water uſed at *Schemnitz*.

They have divers ways of taking the Gold out of its Ore, by burning the Ore, by melting, by adding Silver Ore and other Minerals, Sand, and Lead, as they find the Ore fluid or fixed. But without Lead they proceed thus:

They break and pound the Ore in Water very fine; then waſh it often, and lay it in Powder upon Cloths, and by the gentle oblique deſcending of the Water over it, and their continual ſtirring it, the earthy, clayiſh, and lighter parts are waſhed away, while the heavier and metalline remain in the Cloths. Theſe Cloths are afterwards waſhed clean in ſeveral Tubs, and the Water, after ſome ſettling, poured off from its Sediment, which Sediment is again waſhed, and ſtirred up in ſeveral Veſſels and Troughs, till at length they ſprinkle Quickſilver upon it, and kneed it well together for an Hour: and then waſhing it again in a Wooden Veſſel, after the ſeparating of much of it which the Quickſilver touches not, by ſtriking this Veſſel againſt their Leg, they bring the Gold and Quickſilver together, in an *Amalgama*, to one Corner of it. From this *Amalgama* they ſtrain as much of the Quickſilver as they can, thro' coarſe Cloths firſt, and then thro' fine; then they put the Maſs remaining upon a perforated Plate, which they ſet over a deep Pan placed in the Earth, in the bottom of which Pan they alſo put Quickſilver. This Pan they cover, and lute the Cover well: and then making a Charcoal Fire upon it, they drive down the Quickſilver yet remaining in the Gold, to the reſt in the bottom of the Pan; then taking out the Gold, they caſt it into the Fire, that it may become purer.

Concerning *Cranach* Gold, I cannot learn that there is any ſuch Gold, or Place where Gold is digg'd, in *Hungary*; but in *Germany* I think there is, for *Agricola* mentions ſuch a Place as *Golde-Cranacum*, and another called *Golde-Crona*.

The extreme Ductility, *and exceeding* Minuteneſs *of the* conſtituent Particles *of* Gold. *By Mr.* Edmond Halley, *n.* 494. *p.* 540.

CXII. It is evident from undoubted Experiment, that Gravity is in all Bodies proportionable to the quantity of Matter in each, and there is no ſuch thing as a Propenſion of ſome more, others leſs, towards the Earth's Center; ſince the Impediment of the Air being removed, all Bodies deſcend, be they ever ſo looſe or compact in Texture, with equal Velocity. It follows therefore, that there is ſeven times as much Matter in Gold as in a Piece of Glaſs of the ſame Magnitude (their Specifick Gravities being nearly as Seven to One) and conſequently, that at leaſt ſix Parts of ſeven in the bulk of Glaſs, muſt be Pore or Vacuity. This ſome Favourers of the *Atomical Philoſophy* have endeavoured to ſolve, by ſuppoſing the primary or conſtituent Atoms of Gold to be much larger than thoſe of other Bodies, and conſequently the Pores fewer.

In order to examine the Magnitude of thoſe Atoms, I informed my ſelf among Wire-drawers, that the very beſt double-gilt Wire was made out of Cylindrick Ingots four Inches in circumference, and 28 Inches long, which weigh 16 Pounds *Troy*; on theſe they beſtow 4 Ounces of Gold, that is, to every 48 Ounces of Silver, one of Gold: and that 2 Yards of the Superfine Wire weighs a Grain. Hence at firſt ſight it appeared, that the length of 98 Yards is in weight 49 Grains, and that a ſingle Grain of Gold covers the ſaid 98 Yards, and that the 10000th part of a Grain is above $\frac{1}{3}$ of an Inch long; which yet may be actually divided into 10, and ſo the 100000 Part of a Grain of Gold be viſible without a Microſcope. And by means of the Specifick Gravities of the Metals, *viz.* Silver $10\frac{1}{3}$ and Gold $18\frac{2}{3}$. I found the Diameter of ſuch Wire, the $\frac{1}{386}$ part of an Inch, and its Circumference the $\frac{1}{123}$ part: But the Gold in thickneſs not to exceed the $\frac{1}{134500}$ part of an Inch; whence it may be concluded, that the Cube of an hundredth part of an Inch would contain above 2433000000 (or the Cube of 1345) of ſuch Atoms. And yet tho' the Gold be ſtretched to ſo great a degree as is here demonſtrated, it ſhews itſelf of ſo even and united a Texture, as not to let the white Colour of the Silver under it appear (even with a Microſcope) thro' any the leaſt Pores; which argues that even in this exceeding thinneſs, very many of thoſe Atoms may ſtill lie one over the other.

CXIII. 1. *An.* 1664. I travelled into the Kingdom of *Mexico*, under the Character of a *Biſcaneer*, and remained in that Country about two Years.

A Mineral like Leaf Gold near Mexico; *By an* Engliſh *Gentleman at* Seville, *n.* 41. *p.* 817.

Some of the Mine-men ſhewed me certain Stones, gathered in great abundance in the Mines of *Taſco*, which they would have to be Amethyſts.

There is a famous Cave, ſome Leagues from *Mexico*, on the North-weſt ſide of the City beyond the Lake. I found it ſituated ſomewhat high, in a place very convenient for Generation of Metals. The Light of a Candle ſoon diſcovered to me on all ſides, but eſpecially above my Head, a gliſtering Canopy gilded with a kind of Leaf-Gold. I heaped together a quantity of the Mineral mixt with Sand, and ſcraped alſo from the Superficies of the Earth, a quantity of the ſame kind of Mineral Leaves; none of which exceed the breadth of a Man's Nail; and with the leaſt handling they divide themſelves into many leſſer Spangles; with a little rubbing they leave ones Hand all gilded over with Gold, and they equalize the moſt refined Gold upon the Touchſtone.

It is reported that the antient *Indians* knew how to make uſe of this Mineral. But the *Spaniards* have never been able to reduce it into a maſſy Form by the Violence of the Fire, or ſeparate it from heterogeneous Subſtances by the mild Trial of Quickſilver. Some indeed of the choiceſt Mines of Silver and Gold, are almoſt of the like nature, till the Impediments are removed, which are certain mineral Viſcoſities, that ſometimes by their oleaginous Fatneſs, and at other times by a fretting Acrimony, hinder the Ingreſs of the Mercury.

To find out therefore a Cure for this Diſeaſe, I began to make Experiment on the Sand, which had been the *Matrix* of the Mineral. I tried it in a ſtrong reverberating Fire, but it did not afford any viſible Fumes. I then

boiled

boiled ſome of it in Water, and having poured that off, I obſerved the *Alcali* left after the Water's Evaporation: And thereby I diſcovered, that it abounded rather in ſulphureous Unctuouſneſs, than ſaline Acrimony. Finding this, I applied firſt the Quickſilver mingled with the ordinary Magiſtrals (as they call them) uſed in that Country to curb and break the Force of the ſulphureous Impediments. But perceiving theſe to be of no effect, I encouraged the Quickſilver with the *Caput Mortuum* of *Vitriol* or *Salt-petre* (kept as a Secret among the chiefeſt Mine-men) but with as little Signs of the Mercury's Operation as before. Then I boiled my Mixture over the Fire; a Way found out in *Peru* in ſuch difficult Caſes; but all to no Purpoſe. Then I deviſed a way to torment it with a corroſive or ordinary ſeparated Water, impregnated with common Salt, and it made a Diſſolution exactly like that of Gold: But having ſteamed away the *Aqua Fortis*, I found a Dirt ſomething yellow, out of which with diſtilled Vinegar, enforced with its own *tartareous Salt*, I extracted a Tincture more curious than uſeful.

An experienced Mineraliſt cemented it with the Powder of vulgar Sulphur, *ſtratum ſuper ſtratum*, and this in a moderate Fire, for 3 Days together; hoping the Sulphur would conſume all the Impediments which kept the Mercury from entring: But (as I told him beforehand) it only ſerved to clog the matter with more ſulphureous Unctuoſity than it had before.

The uſe of Mercury in ſeparating Silver from the Ore; By the ſame Engliſh Gentleman, ib. p. 820.

2. When Silver is generated, as commonly it is, in certain rocky Stones abounding with bituminous coroſive mixture, ſo as it is impoſſible to free it totally from its corrupt *Matrix* by the violent Way of melting, whatever auxiliary Ingredient may be added, as Lead and artificial Salts, and the like, becauſe thoſe ſulphureous and vitriolick Compounds (in the way of Fuſion) meeting together with the Silver, ſublime Part of it away, in a volatile Fume, by their corroding Acrimony, calcinating and vitrifying the other Part, and robbing the Artificer of half his Gain: in this Caſe the Uſe of Quickſilver is found moſt advantageous. They practiſe thus:

Having reduced the Ore into ſmall Stones, they calcine it firſt in a reverberating Oven, yet with a moderate Fire for fear of Fuſion, and driving away into the Air part of the Treaſure; the volatile Parts being by Nature not perfectly mixed *per minima* with the fixed, as they afterwards come to be by Induſtry and Art. And I have heard ſome of the more intelligent *Mineraliſts* ſay, that they judge their metallick Labours and Operations to be many times not ſo much a reaping of Silver ready made, as a kind of artificial compounding and bettering of that, which Nature had left diſperſed and imperfect.

This Calcination ſerves chiefly to free the Mineral from many Infirmities, that hinder the Operation of the Quickſilver; and it ſerves alſo to diſcover by the Colour of the Fumes it yields, what corroſive Mixture chiefly abounds in it: Beſides that, it renders the Ore more tractable and pliant under the Mill-ſtone, which is to reduce it to ſmall Flour, before the Application of the *Mercury*. This is chiefly obſerved in thoſe Silver Veins, that are of a hard and dry Complexion; yet thoſe which are uſually more ſoft, abounding

ing in *Oleaginous Sulphurs*, before burning, are firſt ground into Powder in ſuch Mills as I have often ſeen in Glaſs-Houſes, and then they receive a gentle Calcination, the *Mineraliſt* mingling therewith ſuitable Ingredients. As if (*e. g.*) the Metal be Sulphureous and Antimonial, Ruſt and Droſs of Iron is found to be an excellent Cure for this Diſtemper: If Martial and abounding in Iron, then Sulphur and Antimony reduced to Powder. And I have found by Experiment that Sulphur has a particular Force to ſoften and diſſolve Iron.

The Ore being ground, calcined and curiouſly ſifted, they divide it into ſeveral Heaps, and then by leſſer Eſſays, they find out how much Silver is contained in every Heap; where it is very ordinary to find only ſix Ounces in 100 Pounds; ſometimes 12, but if it yield 18, it is eſteemed a very rich Vein; yet ſometimes there are great Maſſes found all of pure Silver, which is called *Virgin Metal.* Then proportionable to the Quantity of Silver in each Heap they beſprinkle them with *Quickſilver*, and that not all at once, but at ſeveral times, ſtirring the *Ore* up and down. If the *Mercury* gives Signs of being *Tocado* (as they call it) *i. e.* if it appear mortified, not in ſmall and clear ſpherical Figures (which is a good Prognoſtick) but in the Form of long Worms of a wan, pale, dark, and leadiſh Colour (which indicate that the *Ore* abounds with Lead and Pewter) it is cured by certain Magiſtrals which have for their Baſis or Maſter-Ingredient calcined *Copper* mingled with Salt.

The Heaps of *Ore* being thus mingled with *Quickſilver*, they are often ſtirred about, the better to incorporate it with the *Silver*. I find, that they have none but conjectural Signs to know when the *Mercury* hath entirely performed its Office in ſeparating all the *Silver* from thoſe heterogeneal Subſtances; the Uncertainty whereof occaſions often very great Loſſes, eſpecially when they work about *Gold*; for in paſſing the right Time, the greateſt Part of the *Gold* flies away in a Fume. But when by the Colour of the *Mercury*, coagulated by the *Silver* in clear maſſy Lumps, they conjecture the Work done, they waſh it by means of three Veſſels ſtanding in order the one under the other; ſo that the Matter in the firſt and higheſt Veſſel being waſhed and ſtirred about with a Mollinet, all the Duſt of the heterogeneous Minerals, that embody not with the *Mercury*, is carried away together with the Water into the other Veſſels, and from thence is quite thrown out by the continual Current of the Water; whereas in the mean while the *Silver* in clotted Lumps, called *Pellas*, is by the Weight of the *Mercury* depreſſed down to the Bottom of the Tubs. Then the *Mercury* with the Silver is taken out of the Veſſels, and diligently ſqueezed in coarſe and ſtrong Linnen; and even with Strokes of a Beetle, the *Quickſilver* is ſeparated as much as may be from the *Silver*. And this Maſs is afterwards reduced, of Molds of the ſhape of the *Indian* Pine Apple, into a Pyramidal or Conical Figure, which they call *Pineas de Plata*, thus faſhioned for the eaſier placing them round about the Ridges of a great Earthen Veſſel of the Form of a blind Alembick; round about the Top of which a Fire being made, all the reſt of the *Mercury* forthwith abandons the *Silver*, and falls to the Bottom, from whence it is recovered, and kept for the like Uſe.

Laſtly, the *Silver* is melted down with the *Liga* (as it is called) which the King of *Spain* allows, by which he returns to the People in *Copper* that fifth Part, which they allow him of all the *Silver*.

I have obſerved, that there is a very ſtrong offenſive Smell, ranker than that of Sepulchres, in ſome Mines; the Workmen telling me, that that is one of the chief Signs of a rich Mine.

Vegetable Silver, ib. 823.

A Friend of mine ſhewed me a very pretty Experiment more curious than gainful; it was a continual budding forth of *Silver* in the Form of a Branch, in a Glaſs, over an indifferent ſtrong Fire of Coals; which ſprouts being clipped off with Sciſſars, and a ſmall ſupply of *crude Mercury* added to the Matter, in a ſmall time there aroſe another Branch of true *Silver*, which had ſucked and converted into metallick Sprigs a conſiderable Portion of the *Quickſilver*. This Motion, and the Increment of the Silver Branches, ceaſed not, as long as the Fire was continued, and freſh *Mercury* applied, for the due Nutriment of this mineral Vegetation. This whole Complex of Ingredients is known to conſiſt only of vulgar *Aqua Fortis* (abſtracted from two Parts of *Vitriol*, and one of *Salt-petre*) and *Quickſilver*, and a ſmall quantity of *Silver*, far leſs than you may reap in a ſmall time from theſe Silver Sprigs: Yet Gain there is none, there being more Expences blown away into Smoak, by the continuance of Fire, in one Month, than can be recovered from this Silver Harveſt in a longer time.

I am of Opinion that in all Tranſmutation of Metals, the imperfect Metal is not totally transformed into the more perfect, by the Subſtance mixed with it: But that the Mixture added to the imperfect Metal, joins itſelf (as I conceive) to thoſe Parts, which being homogeneal, ſymbolize together with the Nature of the more perfect, whereby the pure metalline Parts are ſeparated from the other heterogeneal impure Sulphurs.

The Art of Refining; *By Dr.* Chr. Merret, n. 142. *p.* 1046.

CXIV. The End of Refining is the Separation of all other Bodies from *Gold* and *Silver*, which is performed four Ways, *viz.* by parting, by the Teſt, by the Almond Furnace or the Sweep, and by *Mercury*. 1. Parting is done with *Aqua Fortis*. Some Refiners, to make the *Aqua Fortis*, take *Salt-petre* 3 Pound, and *Dantzick* (not *Engliſh*) *Vitriol* 2 Pound (for the *Engliſh Vitriol* makes a weaker Water, and a dirty coloured Verditer, and wholly ſpoils it.) After they are well bruiſed and mixed in a Mortar, then diſtil 100 Pound of the Materials, put into a caſt Iron Pot, after this manner:

Build a Furnace 2 Yards high or more; and at the Top place in your Iron Pot: To which fit a Head of Earth, like the Head of a large Diſtillation Alembick for Chymical Oils, which muſt have a large Belly, branching it ſelf out 8 Inches from the Iron Pot, into 3 Branches; one whereof in the midſt, comes directly ſtraight forwards, two other lateral ones come obliquely: All which Branches are 4 or 5 Inches hollow in Diameter, and 5 or 6 long. To theſe Branches are fitted Glaſs Bodies, narrow and hollow at both Ends, large and globous in the midſt. Theſe muſt be exceedingly well luted on with Colcothar, Rags, Flour, and Whites of Eggs. To this firſt Glaſs Body is luted on another Glaſs, of the ſame Figure and Size, and in order 8 alike in all, till they come to the Receiver, which is an ordinary Gallon Glaſs. All theſe Rows of Glaſſes lie on Boards ſhelving from the Head to the Receiver. The two upper Receivers or Glaſs Bodies need exceeding good Luting, for the reſt ordinary Lute will ſerve.

The Lute is made of good Loam, ſome Horſe Dung, and a little *Colcothar*; although the two former do well.

A little Fire, and that of *Newcaſtle* Coals, does the Work. And you need never break or unlute any of the Receivers, but the lowermoſt.

The *Aqua Fortis* being diſtilled off, is put into a large earthen Pot, and there is added of fine *Silver*, one or two Penny Weight (which is called Fixes) to every Pound of *Aqua Fortis*, which within four Hours will purge it from all Dirt and Impurity, and make it fit for Parting, which is thus done:

If their *Silver* gilt be fine enough for Wire, they only melt it in a Wind Furnace, and caſt it melted into a large Tub of Water, that they may have it in ſmall Pieces; but if it be but Standard, they firſt fine it on the Teſt. Theſe ſmall Pieces taken from the Water, being well dried, are put into a Glaſs taper-faſhioned, a Foot high, and ſeven Inches at the Bottom; and then the Glaſſes are charged with *Aqua Fortis* about two thirds of it, and ſet in a Range of Iron covered two Inches deep with Sand, and a gentle Charcoal Fire is made under it.

Small Bubbles will ſoon ariſe, and the Water alſo run over. If ſo, they take off the Glaſſes, and hold them till it does *defervеſcere*, or elſe pour out ſome of it into a Veſſel which is at hand.

If *Lead* be mixed with it, they cannot keep it from running over.

When the Water hath been once quieted from this Ebullition, it will riſe no more.

The Greenneſs of the Water manifeſteth the quantity of *Copper* contained in it.

If the Water boil over, it will penetrate the Bricks and Wood.

They commonly let it ſtand a Night on the Iron Range, with a gentle Heat under it, and in the Morning ſoftly pour off the Water impregnated with all the *Silver*; all the *Gold* lying like black Dirt at the Bottom; which being waſhed out is put into ſmall Parting-Glaſſes, and ſet over the Sand with their Conduit Water for an Hour, and then the Water poured off. This is repeated 5 or 6 times, to ſeparate the *Salt* from the *Gold*, which is now fit to be melted, and caſt into Ingots.

To regain the *Silver*, they have large round Waſhing Bowls, lined within with melted Roſin and Pitch (for otherwiſe the Water would eat the Wood and penetrate the ſides of the Bowl) covered with Copper Plates 10 Inches long, 6 wide, and half or more thick. Into which Bowls they pour good ſtore of Water (the more, the better the Verditer) and then the Silver Water; which working on the ſofter Metal of *Copper*, leaves all the *Silver* in moſt fine Sand at the Bottom, and Sides of the Bowl) and Plates of Copper; which being taken out, is waſhed, dried and melted for any Uſe.

If any Braſs or Shroffe Metal be in the Plates, they gather very little of the *Silver*; the latter mixing with the *Silver*.

With the Copper-water, poured off from the *Silver* and Whiting, Verditer is made thus: They put into a Tub a hundred Pound Weight of Whiting, and thereon pour the Copper-water, and ſtir them together every Day for ſome Hours together. And when the Water grows pale, they take it out, and ſet it by for farther Uſe, and pour on more of the green Water; and ſo continue till the Verditer be made; which being taken out, is laid on large Pieces of Chalk in the Sun, till it be dry for the Market.

The Water mentioned to be taken from the Verditer, is put into a Copper, and boiled, till it come to the thickneſs of Water-gruel, now principally conſiſting of *Salt-petre* reduced, moſt of the *Spirit* of *Vitriol* being gone with the Copper into the Verditer; a Diſh full whereof being put into the other Materials, for *Aqua Fortis*, is re-diſtilled, and makes a double Water, almoſt twice as good as that without it.

The Teſt. 2. By the Teſt, all Metals are ſeparated from *Silver*, except *Gold*, becauſe they ſwim over it, when they are all melted together.

The Teſt is thus made: They have an Iron Mould, oval, and two Inches deep. At the Bottom hereof are 3 Arches of Iron, ſet at equal diſtances, two Fingers wide, if the great Diameter of it be 14 Inches long, and ſo proportionably in greater or leſſer Teſts. This Cavity they fill with fine Powder of Bone-Aſhes, moiſtened with *Lixivium*, made with Soap-Aſhes. Some uſe Cakes of Pot-Aſhes, or other Aſhes well cleanſed, and ſo preſſed well together with a Muller, that it becomes very cloſe and ſmooth at the Top. There is left above, a Cavity in the midſt of it to contain the melted *Silver*. This Cavity is made greateſt in the Middle, for the Bone-Aſhes come up parallel to the Circumference of the Mould, only a ſmall Channel in that End which is moſt remote from the Blaſt, for the running off of the baſer Metals, and ſo is made declive to the Centre of the Teſt, where it is not above half an Inch deep.

The Teſt thus made, is ſet a nealing 24 Hours, and then it is ſet in a Chimney a Yard high, parallel almoſt to the Noſe of a great Pair of Bellows; and then therein is put the *Silver*, which being covered all over with Billets of barked Oak, the Blaſt begins, and continues all the while ſtrongly. The *Lead* purified from all *Silver* (which they call the Soap of Metals) firſt put in, melts down with the *Silver*, and then the *Lead* and *Copper* ſwim at the Top, and run over the Teſt; whoſe Motion the Refiner helps with a long Rod of Iron, drawn along the Surface of the *Silver*, towards the forementioned Slit, and often ſtirring all the Metal, that the impurer may the better riſe. And by continuing this Courſe, Separation is made in 2 or 3 Hours.

The greateſt part of the *Lead* flies away in Smoak.

If the *Lead* be gone before all the *Copper*, it will riſe in ſmall red fiery Bubbles; then they ſay, the Metal drives, and they muſt add more *Lead*. The Force of the Blaſt drives the higher Metals to the lower Side of the Teſt, and helps its running over.

When the *Silver* is fully fined, it looks like moſt pure *Quickſilver*; and then they take off their Sogs, and let it cool. In the cooling, the *Silver* will frequently from the Middle ſpring up in ſmall Rays, and fall down again. If moiſt *Silver* be put into that which is melted, it will ſpring into the Fire.

A good Teſt will ſerve two or three Firings.

So ſoon as the *Silver* will hold together, they take it out of the Teſt and beat it on an Anvil into a round Figure, for the melting Pot, which being ſet in a Wind Furnace ſurrounded with Coal, and covered with an Iron Cap that no Charcoal fall into it, is then melted.

If any Droſs or Filth be in the Melting Pot, they throw in ſome *Tincal*, which gathers the Droſs together, that it may be ſeparated from it.

Theſe Melting-Pots are never burned, but only dried, and laſt a whole Day, if they be not ſuffered to cool; but if they once cool, they infallibly crack.

The Almond Furnace.

3. In the Almond Furnace, or Sweep, all ſorts of Metals are ſeparated from Cinders, parts of Melting-Pots, Teſts, Brick, and all other harder Bodies; which muſt be firſt beaten into ſmall Pieces with a Hammer on an Iron-Plate.

Thoſe which ſtick but ſuperficially to the *Silver*, they waſh off thus: They have a wooden round Inſtrument two Foot wide, ſomewhat hollow in the Middle, with a Handle on each Side; on this they put the Materials, and hold them in a Tub of Water below the Surface; and ſo waving it to and fro, all the lighter and looſer Matter is ſeparated from the Metal.

The Furnace is 6 Foot high, 4 Foot wide, and 2 Foot thick, made of Brick; having a Hole in the midſt, at the Top 8 Inches over, growing narrower towards the Bottom of it, where on the Fore-part, it ends in a ſmall Hole, environed with a Semicircle of Iron, to keep the molten Metal. About the Middle of the Back, there is another Hole to receive the Noſe of a great Pair of Bellows.

When the Furnace is annealed with Charcoal and hot, they throw two or three Shovels of Coals to one of the forementioned Stuff, and ſo proceed during the whole Work, which continues three Days and Nights, without Intermiſſion. After eight or ten Hours, the Metal begins to run; and when the Receiver below is pretty full, they lade it out with an Iron Ladle, and caſt it into Sows in Cavities, or Forms, made with Aſhes.

They frequently ſtop the Paſſage-Hole with Cinders, to keep in the Heat; and when they think a Quantity of Metal is melted, they unſtop the Hole to paſs it off.

If the Stuff be hard to flux, they throw in ſome Slag, which is the Recrement of Iron, to give it Fuſion.

A ſtinking blue Smoak proceeds from the Furnace, and all the By-Standers put on the Colour of dead Men.

To get the *Silver* from theſe Metals, and to refine their *Copper* from the Litharge, they now uſe no other Art than that of the Teſt.

By Quick-ſilver. 4. By *Quickſilver*, the Filings of Gold and Silver are ſeparated from Duſt, *&c.* This Duſt is put into a Hand-Mill with *Quickſilver*, and being continually turned upon that and the Metals an *Amalgama* is made of them, and fair Water poured in, carries off the Duſt, as it runs out again by a ſmall Quill.

This *Amalgama* is put into an Iron, with a Bolt-head ſet into the Fire, having a long Iron Neck 3 Foot long, to which is fitted a Receiver. The Fire diſtills off the *Mercury* into the Receiver, and the Gold and Silver remains in the Bolt-head.

Experiments of refining Gold with Antimony, by Dr. Jonat. Goddard. *n.* 138. *p.* 953. CXV. 1. There was taken of Crown Gold (which is, as they call it) of 22 Kerats fine, or $\frac{11}{12}$; and the Alloy is part Silver, part Copper (more of the Copper for the moſt part) to the quantity of 178 Grains. This was melted down, with 2 Ounces and 2 Drams of *Antimony* (about 6 times as much as the Gold.) And becauſe the Gold was put in Plates, for the more certain Melting and Mixture, the firſt Regulus of Gold being ſeparated from the Antimony, both were powdered apart, and the Regulus in the Melting-Pot laid upon the ſame Antimony, and ſo both melted down again. In both which Meltings, ſuch an Heat was given, as made all of a clear Light, even red hot and boiling. Then the Pot was taken out of the Fire, and all permitted to ſeparate, ſettle and cool in it. Upon the breaking of the Pot, the Gold (being very diſtinct in the Bottom, and eaſily ſeparated from the Antimony) weighed 163 Grains.

N.B. That this Way of cooling all in the Pots was obſerved in all the following Experiments, for the more certain ſeparation and ſettlement of the Regulus, without Effuſion into the Antimony-Horn (as they call it) or hollow Iron Cone. Which Effuſion by confounding and cooling the Mixture, may be ſome Hindrance to a more perfect Separation. And to be ſure in the Bottom of the Cone, there is always a thin Cruſt of the crude Antimony, troubleſome to be ſeparated without taking off ſome part of the Regulus.

Note alſo, that Borax was uſed in every Pot, for prevention of the ſticking of the Regulus to the Bottom, and the Antimony to the Sides of it, ſo that both were gotten off clean, and in full quantity.

Of the Regulus, a Piece was broken off, which weighed 38 $\frac{1}{2}$ Grains, and was kept to be refined upon the Coppel apart; the Weight of the remainder therefore was 124 $\frac{1}{2}$ Grains, which being powdered and put upon 2 $\frac{1}{4}$ Ounces of freſh Antimony and melted down, the Regulus weighed 74 Grains.

The other Pieces of 38 $\frac{1}{2}$ Grains being refined on a Coppel, from the Antimonial Subſtance mixed with it, by Exhalation, prompted ſome time with a Blaſt upon it, eſpecially toward the latter End, as in all the following Experiments of refining upon the Coppel, 30 $\frac{1}{2}$ gr. and upon melting with Borax in a Crucible, loſt not above half a Grain. So that the Weight of the whole to the Gold it held, was 38 $\frac{1}{2}$ to 30 $\frac{1}{2}$, or the Gold almoſt $\frac{5}{6}$ of the whole. The latter Regulus weighing 74 gr. being refined in the ſame manner, weighed 63 gr. the Gold holding proportion to the whole, as 63 to 74; that is, near upon $\frac{6}{7}$ of the whole. So that the ſame Regulus of Gold and Antimony, in paſſing thro' new Antimony, tho' it loſe in Weight, yet it is richer in Gold; and appears ſo to Senſe, being of a redder Complexion, more tough and harder to powder.

Both the parcels of Antimony were ſeverally mixed, with equal Weight both of Tartar and Nitre, and then fired, and ſo reduced to a Regulus. Then the Regulus of each, exhaled and blown off upon Coppels. Of the firſt parcel of Antimony wherewith the Gold was firſt melted, the Regulus being exhaled, there remained in Gold 36 gr. Which upon melting in a Crucible, loſt ſomewhat, but ſcarce half a gr.

Of the ſecond Parcel of Antimony, wherewith the firſt Regulus of Gold and Antimony, weighing 124 $\frac{1}{2}$ gr. was melted, there remained in Gold 27 gr.

All the other Parcels were fine Gold to Senſe, upon the touch, only that out of the firſt Antimony was apparently unfine and pale, from the Silver in the original Alloy mixed with it, as appeared by comparing on the Touch-ſtone, with ſovereign Gold allayed with Silver; holding (to the Judgment of Senſe) about a 4th part of Silver, as the Sovereign Gold doth a 6th. Neither was it altogether free from Copper; becauſe upon nealing, it always turned black on the Surface. But for the more exact Diſcovery, it was taken and firſt refined with Lead upon a Coppel, for ſeparation of any Copper that might be in it. Upon which Operation, it came forth 33 $\frac{1}{2}$ Grains, which was 2 $\frac{1}{2}$ Grains leſs than it was before. Afterwards this laſt was melted, with betwixt two and three parts of Silver, and ſo wrought in *Aqua Fortis*, for ſeparation of the Silver: And there remained in Gold but 28 $\frac{1}{2}$ Grains, and yet it appeared upon the Touch not fine, but paler than fine Gold, and deeper than Crown Gold allayed with Silver. So that what remained in it, was neceſſarily of Silver, and it might be eſtimated about twenty-three Kerats fine, or to hold in fine Gold about twenty ſeven Grains. What loſs of Gold was upon this refining with Antimony, may be eaſily computed. Firſt, 14 $\frac{5}{6}$ Grains for alloy, being deducted from the firſt quantity of Crown Gold, weighing 178 Grains, the Remainder is 163 $\frac{1}{6}$ Grains. Then the ſeveral Parcels of fine Gold, which was recovered, and ſeparated from the Regulus of Antimony and Gold, and alſo from the Parcels of crude Antimony reduced to Regulus, are to be added together; that is, 30 Grains, 63 Grains, 27 Grains, and 27 Grains, all which amount to 147 Grains, which being deducted from the firſt quantity of 163 $\frac{1}{6}$, the difference is 16 $\frac{1}{6}$ Grains, which is more than $\frac{99}{1000}$ or very near a Tenth.

Where and how this loſs of Gold ariſeth, it appears thus. The firſt Parcel of the Antimony was charged with 163 $\frac{6}{1}$ Grains of fine Gold; of which the firſt Regulus, weighing 163 Grains (in proportion to that piece of it weighing 38 $\frac{1}{2}$, and producing upon refining on the Coppel 30 Grains) muſt hold 127 Grains of fine Gold. Then 27 Grains of fine Gold, eſtimated to be contained in the 36 gr. ſeparated from this firſt Parcel of *Antimony*, being added to the 127 gr. makes 154 gr. which is ſhort of $163\frac{1}{6}$ gr. by $9\frac{1}{6}$ gr. and ſo much was irrecoverably loſt in this Parcel of *Antimony*.

Then the Piece of *Regulus* weighing $124\frac{1}{2}$ gr. melted with the ſecond Parcel of *Antimony* (in proportion to the former Piece broke off, weighing 38 gr. and upon refining yielding 30 gr. of pure Gold) muſt contain 98 gr. of the like Gold; and ſo much this ſecond Parcel of *Antimony* muſt be charged with. Towards which the *Regulus* weighing 74 gr. being refined, produced 63 gr. and that Gold, ſeparated from this ſecond Parcel of *Antimony*, weighing 27 gr. being added, make 90 gr. ſhort of the firſt Quantity charged upon this part of the firſt *Regulus* by 7 gr.

Some Loſs of Gold may be upon powdering of the *Regulus*, as alſo by the Papers neceſſarily uſed; but the greateſt Loſs was by ſmall Sparks, which continually fly up, while the *Antimony* is in a boiling Heat with the Gold, many whereof fly over the Pot into the Fire. That theſe Sparks were Gold appeared thus: when many of them ſtuck to an earthen Cover, and had coloured it of a deep Red, *Aqua fortis* did not fetch off or diſſolve any thing, but *Aqua Regis* run off it yellow, like a Solution of Gold in the ſame Water.

Some Loſs of Gold may alſo be upon the firing of the *Antimony* with *Tartar* and *Nitre*, which make a vehement Conflagration with abundant Sparkling.

It hath been ſuſpected that ſomewhat of the Gold may be diſſipated by the Blaſts upon the Coppels, in refining it from the *Antimony* remaining in it. But this is not ſo probable, beauſe Refiners, to give their fine Gold a higher Colour for gilding, put to it a third or fourth Part of *Crude Antimony* or of *Regulus of Antimony*, which is a conſtant Practice among ſome of them, and with a great Heat and ſtrong Blaſt work it off; in which Operation, in ſome Ounces of Gold, they loſe not one Grain.

With the ſame Antimony, *ib. p.* 958. 2. There was taken of Crown-Gold $141\frac{1}{2}$ gr. which was melted with $1\frac{3}{4}$ Ounce of *Antimony*, and the *Regulus* weighed 123 gr. from this a Piece weighing 30 gr. was broken off, and reſerved for refining by itſelf; the remainder, being 93 gr. was melted down again with the ſame *Antimony*, being powdered and put on the top; and thereupon the *Regulus* came forth, weighing 91 gr. So that here was no conſiderable Loſs. And there is ground to ſuſpect, that it might be upon ſome accidental Difference in the managing, that the *Regulus* did not ſo perfectly ſeparate and ſettle; for in all other Experiments of melting the ſame *Regulus* again with the ſame *Antimony*, the *Regulus* gained Weight.

From this ſecond *Regulus*, a Piece was broken off and reſerved for refining apart, weighing 36 gr. the remainder being 55 gr. was melted down, as the former, and in the ſame *Antimony*. Whereupon the *Regulus* came forth in Weight 72 gr. 17 gr. being here gained.

The firſt Piece of 30 gr. being refined upon the Coppel, produced of fine Gold 24 gr. and the ſecond Piece of 36 gr. produced 28 gr. and the *Regulus* (upon the third Melting) of 27 gr. produced 55 gr. So that each of the Pieces contained about 4 Fifths of Gold, and but one Fifth of Antimonial Subſtance in it, yet loſing ſomething of that proportion at each Melting, though the *Regulus* gained Weight; both which are contrary, in repeating the Melting of the *Regulus* with freſh Antimony, as in the former Experiments.

The remaining Antimony being reduced to a *Regulus* by firing with *Nitre* and *Tartar*, as before, and that *Regulus* exhaled upon the Coppel, there remained of *Gold* 19 gr. This was leſs Fine than that fetched out of the firſt *Antimony* in the former Experiment. But this Impurity was wholly from the Alloy; and upon refining it, firſt with Lead upon the Coppel for fetching out the Copper, it weighed $17\frac{1}{2}$ gr. having loſt $1\frac{1}{2}$ gr. and then with the *Aqua fortis*, after the melting down with more than the double Weight of *Silver*, upon which Operation there remained 15 gr. and that not perfect fine, but retaining ſomewhat of *Silver*; but finer than Crown Gold allayed with *Silver*; upon the Touch, about 23 Kerats.

The Loſs of *Gold* is thus computed. From the firſt Quantity of $141\frac{1}{2}$ gr. a 12th part or about $11\frac{5}{6}$ gr. being deducted for Alloy, the Remainder is $129\frac{4}{6}$ gr. And the ſeveral Parcels of fine *Gold* produced of the *Regulus*, according to the Account given in particular, being 24 gr. 28 gr. 55 gr. $14\frac{1}{2}$ gr. all together make $121\frac{1}{2}$ gr. ſhort of the firſt Quantity by $8\frac{1}{6}$ gr. or very near one Sixteenth.

3. A Parcel of Crown-Gold, weighing $82\frac{1}{2}$ gr. was melting down with an Ounce of *Antimony*, and the *Antimony* was exhaled in a Crucible to a *Regulus*. Then the *Antimonial* Part of that *Regulus* was exhaled on a Coppel: Whereupon there remained 84 gr. or $1\frac{1}{2}$ gr. more than the firſt Quantity. This muſt happen for want of a Heat ſtrong enough at laſt to force off all the *Antimonial* Subſtance. Whence afterward, upon melting in a Crucible, it came forth 80 gr. the $2\frac{1}{2}$ wanting, being leſs than the leaſt Part of the Proportion of Copper, that muſt be in it, according to the uſual Alloy of Crown Gold. And that there remained Copper in this Gold, appeared by the black Complexion of it upon Nealing; as alſo by the Loſs upon working it with Lead on a Coppel; whereupon it came forth only 76 gr.

By exhaling the whole Antimony, *ib. p.* 960.

So that *Antimony* in a far greater Proportion, doth not ſo much, as *Lead*, in exhaling or ſeparating Copper from Gold; if the Work be done meerly by Exhalation; but doth only retain it with itſelf, whilſt the Gold ſeparates and ſettles in a *Regulus* at the bottom. Neither is it ſo deſtroyed, but that it may, in part at leaſt, be united to the Gold again.

CXVI. Papers *of leſs General Uſe*, Omitted.

n.39. p.530. 1. Articles of Inquiries concerning Mines; by Mr. *Rob. Boyle.*

n.56.p.1139. 2. Some Uſes of *Vaults* and *Cold Conſervatories* in diſcovering Minerals, intimated; by Dr. *Jo. Beale.*

n.450. p.73. 3. Several *Coal Boreings* near *Leeds* in *Yorkſhire*, in the Year 1659, for the Concerns of a private Family, communicated by Dr. *M. Liſter.*

n.93.p.6012. 4. Enquiries concerning *Quarries* and *Stones*, and the ancient Way of *Tempering Tools*, for *cutting Porphyry* and other hard *Marbles.*

n.249. p.49. 5. Several *Curioſities* relating to *Amber*, lately ſent to the *Royal Society* from *Philippus Jacobus Hartmannus*, and which are now in their *Repoſitory* at *Greſham College.*

n.20. p.359. 6. Enquiries about the *Salt-Springs* in *Worceſterſhire* and *Cheſhire*; by Dr. *Beale.*

n.193. p.50. 7. Queries concerning *Salt-petre.*

n. 6. p. 103. 8. The Way uſed in the *Mogul*'s Dominions, to make *Salt-petre.* Extracted from Mr. *Thevenot*'s *Voyages.*

n.265.p.632. 9. Some *Natural Curioſities* ſent the *Royal Society* from *Sicily*; by Dr. *Peter Silveſter.*

CXVII. Accounts *of* Books Omitted.

n. 6. p. 109. 1. The *Mundus Subterraneus* of *Athanaſius Kircher.*

n.77.p.3016. 2. *Admirandorum* Foſſilium, *quæ in Tractu* Hildeſheimenſi *reperiuntur*, *Deſcriptio*; *Iconibus Illuſtrata*; *de* Frederico Lachmund Hildeſheimi, 1669, in 4*to.*

n.207. p.38. 3. *Lezzioni alla Natura dele* Moffette, &c. Diſcourſes concerning the Nature of *Damps*; by *Leonardus Capuanus*, a Member of the *Academy* of the *Inveſtigantes. Naples*, 1683. in 4*to.*

n.219.p.215: 4. *Diſſertationes Medico-Phyſicæ de* Antris Lethiferis; *de Montis* Veſuvii Incendio; *de ſtupendo* Oſſium Coalitu, *de Immani* Hypogaſtrii *ſarcomate*, *a* Bernardo Connor, *M. D.* Oxon. 1695. *in* 8*vo.*

n.60.p.1084. 5. Franc. Travagini, *ſuper Obſervationibus a ſe factis tempore Ultimorum* Terræ Motuum, *ac potiſſimum* Raguſiani, *Phyſica Diſquiſitio*; *ſeu*, *Gyri Terræ Diurni Indicium.* Lugduni Bat. 1669. in 4*to.*

n.75.p.2260. 6. *Hiſtoria & Meteorologia* Incendii Ætnæi, *Anno* 1669. Joh. Alph. Borelli, Regio Julio. 1670. in 4*to.*

n.203.p.893. 7. *Epiſtola ad* Regiam Societatem Londinenſem, *qua de nuperis* Terræ Motibus *diſſeritur*, *& vera eorum Cauſa eruuntur.* Lond. 1693. in 4*to.*

n.81.p.4030. 8. A Philoſophical Eſſay, declaring the probable Cauſes of Stones in the greater World, in order to find out the Cauſes and Cure of the *Stone* in the Kidneys and Bladder of Men; by Dr. *Tho. Sherly. Lond.* in 8*vo.*

9. Hiſtoire des *Joyaux* & des Principales Richeſſes de *l'Orient* & de *l'Occident*, par le Sieur *Chapuzeau*. n.23.p.429.

10. An Eſſay about the Origin and Virtues of *Gemms*, by the Honourable *R. Boyle*, Eſq; *Lond.* 1672, in 8*vo*. The ſame in Latin. n.84.p.4095. n.87.p.5082.

11. *Eraſmi Bartholini* Experimenta *Cryſtalli Iſlandici Diſ. Diaclaſtici*, quibus mira & inſolita *Refractio* detegitur. *Hafniæ* 1669. n.67.p.2039.

12. Hiſtoria *Amber-Griſeæ*, Auth. *Juſto Klobio*. n.28.p.538.

13. Diſcription de la piece de *Ambergris* que la Chambre d' *Amſterdam* a reçue des *Indes Orientales*, peſant 182 *Livres:* Avec un petit Traite de ſa Origine & de ſa Vertue, par *Nicholas Chevalier*, à *Amſter.* 1700. in 4*to*. n.263.p.578.

14. *Jo. Ludov. Ganſii* M. D. *Coralliorum* Hiſtoria, *Francofurti* 1669. in 12°. n.58.p.1201.

15. The Natural Hiſtory of *Nitre*, or Philoſophical Diſcourſe of the Nature, Generation, Place, and artificial Extraction of *Nitre*, with its Virtues and Uſes, by *Will. Clark*, *Lond.* 1670. in 8*vo*. n.61.p.2008.

16. Scrutinium Chymicum *Vitrioli*. Auth. *Joh. Georgio Triumpho*. *Jenæ* 1667. in 4*to*. n.40.p.810.

17. *Theod. Kerkringii* M. D. Commentarius in *Currum Triumphalem Antimonii Baſil. Valentini*, a ſe Latinitate donatum. *Amſtelodami* 1671. in 12°. n.71.p.2162.

18. *Frederici Hoffmanni* Fred. Fil. M. D. Exercitatio Medico-Chymica de *Cinnabari Antimonii*. *Lugd. Bat.* 1685. in 8*vo*. n.176.p.1208.

19. De *Lacte Lunæ* Diſſertatio Medica *Joannis Danielis Majoris*, P. & M. D. *Kiloni* 1667. in 4*to*. n.60.p.1086.

20. *Metallographia*, or an Hiſtory of Metals, by *Jo. Webſter*, Practitioner in Phyſick and Chirurgery, *Lond.* 1670. in 4*to*. n.66.p.2054.

21. 1. The firſt Book of the *Art of Metals*, written in *Spaniſh* by *Alonſo Barba*, &c. and *Engliſh'd* by the Right Honourable *Edward* Earl of *Sandwich*, *Lond.* 1674. in 8*vo*. n.108.p.187.

2. The ſecond Book of the *Art of Metals*, wherein is taught the common Way of refining *Silver* by *Quickſilver*, with ſome new Rules added for the better Performance of the ſame; written in *Spaniſh* by *Alonſo Barba*, and *Engliſh'd* by the Right Honourable *Edward* Earl of *Sandwich*, *Lond.* 1674, in 8*vo*. n.109.p.211.

22. Prattica Minerale del Marcheſe *Marco Antonio* della *Fratta*, in *Bologna*, 1678. in 4*to*. Ph. Col. n.3. p.80.

23. *Fleta Minor*, or the Laws of Art and Nature in knowing, judging, and aſſaying, fining, refining, and inlarging the Body of confined Metals, *&c.* By Sir *Jo. Pettus*, n.147.p.189.

24. A Touchſtone for Gold and Silver Wares, or a Manual for Goldſmiths, and all other Perſons, whether Buyers or Sellers, or Wearers of any manner of Goldſmiths Work, *&c.* By *W. B.* of *London*, Goldſmith, in 8*vo*. n.132.p.814.

25. *Joh. Joachimi Becheri Spirenſis*, M. D. Experimentum Chymicum Novum, quo artificialis & inſtantanea *Metallorum Generatio & Tranſmutatio* ad Oculum demonſtratur. *Francofurti* 1671, in 8*vo*. n.74.p.2235.

CHAP. IV.

Magneticks.

Loadſtone found in Devonſhire; *By Dr.* Edward Cotton, *n.*23. *p.* 423.

I. 1. A Conſiderable Loadſtone was digged out of the Ground in *Devonſhire*, which weighed 60 *l.* It takes up no great weight, yet it moves a Needle about 9 Foot diſtant. Some part of it was broken off, which being in its proper Place, adds much Strength; for without that, it moves not much more than 7 Foot.

By Mr. J. Beaumont. Ph.Col. *n.*1. *p.* 8.

2. I can aſſure you, that thoſe Courſes, Veins or Loads, where Loadſtones are found in the lower parts of *Devonſhire* (either as they lie ſparingly here and there amongſt Iron Ore, or as they lie in conſiderable Bodies with it) do all generally run Eaſt and Weſt; which is contrary to the Imagination of thoſe who have thought that the *Loadſtone* gave a northerly Direction, becauſe its natural Poſition in its Mine was (as they fancied) North and South.

Magnetical Obſervations; By . . . *n.*23. *p.* 423.

II. 1. A noble Perſon did affirm, That a Needle of a Sea-Compaſs, put in a good Iron Mine (which, he ſaid, yielded 23 Pounds of Metal, out of 120 Pounds of Ore) was not ſenſibly moved thereby.

2. Intelligent Perſons ſay, That all the perfection of our Sea-Compaſſes, as yet, conſiſted in this, That the Needle be touched with good *Loadſtones*, and well librated, and that the Variation be truly placed.

By Mr. Sellers, *n.* 23. *p.* 423. *n.*26. *p.* 478.

3. I have often made Trial with many Needles, touching them in each Hemiſphere of the Stone, with all Variety of ways I could imagine, to find if it were poſſible by that means, to cauſe any of theſe Needles to vary in its Direction; but all of them conformed to the Magnetical Meridian, ſtanding North and South, as other Needles, that were touched upon the very Pole of the Stone.

All Needles touched upon different *Loadſtones* of ſeveral bigneſſes and different Virtues, in all parts of the World, agree in this Magnetical Harmony, that they all give the ſame Directions.

Having ſometimes drawn a Needle only over the Pole of the Stone, within the ſphere of its Virtue, without at all touching the Stone; it hath received the ſame directive Quality, tho' not altogether ſo ſtrong as if it had been really touched upon the Stone itſelf. I have alſo touched Needles with faint ſtrokes, and other Needles with ſtronger; all theſe Needles received the ſame effect upon the Stone, both for Strength and Direction. But the nature of the Steel, whereof the Needle is made, and the temper that is given thereunto, cauſeth different Effects, as to the Strength it receiveth from the Stone. So that I can infuſe ſuch Virtue into a piece of Steel, that it ſhall take up a piece of Iron of 2 Ounces Weight or more; and give alſo to a Needle, the Virtue of conforming to the Magnetical Meridian, without the help of a *Loadſtone*, or any thing elſe; that hath received Virtue therefrom.

4. I took a Loadſtone unpoliſhed, which attracted but meanly; and I heated a Lath-Nail glowing hot, nimbly applying the North Pole of the ſaid Magnet to it, which quickly took it up, and held it ſuſpended. Then I caſt the Stone into the Fire, and when it was red hot, I applied the North Pole to another Lath-Nail cold and untouched before, which it took up but faintly, yet held it ſuſpended. Two or three Days after, I found that the Loadſtone attracted then as ſtrongly, as before it was caſt into the Fire.

By Mr Sam. Colepreſs, n. 27. p. 500.

III. All the way from *England* to 10 deg. North Latitude, the North Point of the Needle reſpected the upper end of the Iron, and the South Point the lower end, very ſtrongly.

The Reſpect of the Needle in a piece of Iron, held perpendicular, in ſeveral Climates; By --- n. 170. p. 1213.

Lat. 9° 42′ N. and Meridian diſtance from the *Lizard* 9° 32′ W. The S. Point of the Needle did ſtrongly reſpect the lower end of the Iron, but the N. Point did not ſo ſtrongly reſpect the upper end, as before. Lat. 4° 33′ N. and the Meridian Diſt. 5° 18′ W. from the *Lizard*, the North Point of the Needle begun to decline from the upper end of the Iron, and the South Point to incline more ſtrongly to the lower end. Lat. 00° 52′ S. and the Meridian Diſt. 11° 52′ W. from the *Lizard*, the North Point of the Needle would not reſpect the upper end of the Iron, nor the lower end neither; but the South Point did ſtill incline to the lower end, tho' not ſo ſtrongly.

Lat. 5° 17′ S. and Meridian Diſt. 15° 9′ W. from the *Lizard*, the South Point of the Needle would turn to the lower end of the Iron, about two Points; but remove the Iron any farther, and it would fly away from it, and reſpect the Poles again; but it would not reſpect the upper end at all; neither would the North Point reſpect either: But lay the Iron Horizontal, and let the ends of the Iron reſpect the Poles of the World, and the North Point of the Needle would turn to the South end of the Iron, and contrarily the South Point of the Needle would turn to the North end of the Iron, and alter its reſpect to the Poles 5 or 6 Points, and no farther; but hold the Iron perpendicular, and put the middle thereof to the Needle, it would ſtill reſpect the Poles.

Lat. 8° 17′ S. and Meridian Diſt. from the *Lizard* 17° 35′ W. the North Point of the Needle would not reſpect the upper end of the Iron, but rather forſake it, but the South Point would ſtill ſomething reſpect the lower end, and alter its true Poſition about 2 Points; but take the Iron and lay it aſlope over the Compaſs, ſo that the upper end be towards the South Pole, and the lower end to the North, and then the North Point would reſpect the lower end, and follow it; but if you point the upper end to the North, and the lower end to the South, the North Point will forſake it. But if you lay it Horizontal, it would do as in the foregoing Obſervations.

Lat. 15° 00′ S. and 20° 00′ W. from the *Lizard*, the South Point of the Needle began to reſpect the upper end of the Iron, and the North Point the lower end, and followed it about one Point; but lay the Iron Horizontal, and the North Point reſpected the South end of the Iron, and contrariwiſe, *&c.*

Lat. 20° 10′ S. and 19° 20′ W. from the *Lizard*, the South Point of the Needle reſpected the upper End of the Iron, and the North Point the lower End pretty ſtrongly, and followed it 3 or 4 Points; but lay it Horizontal, and it would do as before.

Lat. 29° 25′ S. and 13° 10′ W. from the Meridian of the *Lizard*, the South Point of the Needle reſpected the upper End of the Iron, and the North Point the lower End ſtrongly.

The Polarity of Iron; By J. C. n. 214. p. 257.

IV. 1. It is known that a Rod of Iron held perpendicular to the Horizon, or inclining, the lower End is its North Pole, or attracts the South End of a Magnetick Needle; and that the ſame End held upwards, becomes a South Pole, ſc. attracts the North End of the Needle and repels the South End.

I call that a mutable Pole, which may be North or South, as you hold it; and a fixed Pole that which does not change however you hold it.

2. The Species of the Pole, whether North or South, may be found by paſſing the Iron Rod through Cork or Wood, and then leaving it to ſwim on Water, it will turn to its proper Pole: But this Way is ſlow and not nice. A better Way to try, for Inſtance a North Pole, is to hold the Iron perpendicular to the Horizon, and to try whether being held under the North End of the Needle, it attracts it. But a yet better Way is to try whether the upper End of the Rod attract the South End of the Needle: for Attraction is more ſenſible than Expulſion.

3. A fixed North Pole may be made with all the Ways and Rods that you can make a fixed South Pole; but not *vice verſa*, for there are many Caſes wherein you can make a fixed North Pole, but not a fixed South Pole: And whatever Way you get a fixed South Pole, it is weaker than a fixed North Pole made the ſame Way. Applying a Needle to an erect Bar, beginning at the Top, and ſo down, the Needle turns not at the Middle, but nearer. Of ſome Rods you cannot make a fixed South Pole primarily, yet you may conſequentially; ſo you may make one End a fixed North Pole, and then the other Ends of thoſe Rods may, without more to do, become a fixed North Pole. But this does not always hold, for the one may be a fixed North Pole, and the other may be a mutable Pole.

4. Fire deſtroys all fixed Poles, ſc. whether made by the *Magnet*, or otherways; but it increaſes, or rather leſs hinders that Magnetiſm, which proceeds from the Earth; ſc. a Wire or Rod of Iron heated at one End, that End is a mutable Pole, but more vigorous while hot than cold. The Vigour of mutable Poles is more in great than little Rods; but it is otherwiſe in fixed Poles.

5. Heat the End of a Rod of Iron red hot (or heat all the Rod) and cool that ignited End Northward, it will be a fixed North Pole; if cooled South it becomes a fixed South Pole. This ſay *Gilbert* and others from Experience: But I ſay, this holds but in ſome Caſes; ſc. if the Rod is ſhort, you cannot make a fixed Pole that Way. Take a round Wire whoſe Diameter is $\frac{1}{5}$ Inch, and length 10 Inches, you cannot produce a fixed Pole by Ignition; but if this Wire were longer, as ſuppoſe 30 Inches long, or never ſo much longer,

it is capable of a fixed Pole by Ignition. Again, take a round rod 30 Inches long, and 1 Inch Diameter, this Rod is not capable of a fixed Pole at that Length, though the leſſer was capable at that Length. And ſo my Experiments give me reaſon to think, that there is no Rod nor Bar of Iron ever ſo thick, but which if it had Length enough would be capable of a fixed Pole by bare Ignition ; for of that I only ſpeak in this Paragraph : And there is no Rod ever ſo ſhort, but which if you make it ſufficiently thin, is capable of a fixed Pole. So when in a Rod I could not obtain a fixed Pole at 21 Inches length in that thickneſs, I could, by making the Rod thinner, produce a fixed Pole even in the length of one Inch and leſs, and the Pole ſhould be of what kind I pleaſed. The *Terminus*, or neceſſary length, for every thickneſs, increaſes more than you would be apt to think.

6. Heat a Rod, or its End red hot, and thoroughly cool this End downwards or towards the *Nadir*, it will have ſomething more Magnetiſm than if cooled Horizontally towards the North. But the better Way is to cool it a little inclining towards the North. I cannot find that multiplicity of Ignitions does produce more Magnetiſm than one good Ignition ; but it muſt be thoroughly ignited. Nor can I find by many Experiments, what quenching in Water ſignifies to the producing or hindering Magnetiſm ; but many Ignitions may accidentally promote it by purifying the Iron.

7. Dr. *Power* ſays, That if we hold a Rod Northward and hammer in that poſition the North End, that will become a North Pole, *i. e.* a fixed North Pole : Contrarily if you hammer the South End. But this is true (as I ſaid before of Ignitions) only in Rods of a certain length and thickneſs.

8. What is ſaid of Hammering is to be underſtood of Filing, Grinding, Drilling, Sawing ; yea, a ſoft Rubbing, provided it is long, will produce fixed Poles. The more heavy the Blows are, *cæteris paribus*, the Magnetiſm is the more. I ſay, *cæteris paribus*, as when the Blows be not ſo heavy in either Caſe as to flat ; for flatting the Iron produces more Magnetiſm, though other things do not vary. A few hard Blows will produce as much Magnetiſm as many, yet a ſoft Blow may produce but little Magnetiſm. The utmoſt Magnetiſm that I could produce in ordinary Rods this Way, did not exceed that which an ordinary *Loadſtone* would have infuſed.

9. Beating many Rods Northward, whoſe Lengths I knew ſufficient, I never failed of producing a fixed North Pole; but Hammering the ſame or like Rod Southward, I found that I could not produce a fixed South Pole, only a mutable Pole ; nay, Hammering one full South, I produced a fixed North Pole. Then I thought the Reaſon might be, that the hammered South End on the Anvil was a little lower than the End which I held in my Hand : Then I held the End higher, and ſo Hammering it South upwards, I never failed producing fixed South Poles in proper Rods.

10. Old Drills and Punches are fixed North Poles, becauſe almoſt conſtantly uſed downward : But now Drills are either mutable Poles or weak North Poles. When I ſay, a new Drill, I do not mean one made upon the Spot, for that is probably a North Pole, becauſe quenched downwards in Water ; but then ſuch Polarity made by bare Ignition, is a weak Pole,

and ſoon decays and turns to a mutable Pole: But I mean a Drill which though never or little uſed, yet has been made ſome Days or Weeks. Drill with this Southward Horizontally, and it is a Chance if you produce a fixed *South-Pole*, but much leſs, if you drill South downward: But if you drill South upwards, you may make it a fixed *South-Pole.*

11. The ſtronger the Polarity is, the longer it will laſt. A weak fixed Pole may degenerate into a mutable Pole in a Day's time; yea, I have known it in a few Minutes, while expoſed to the Air, and held in a poſition contrary to its Pole; on the contrary, we find Needles touched with good *Loadſtones*, hold that Virtue a great while, if kept from Air, and in a meridian Site.

12. The *Loadſtone* itſelf will not make a fixed Pole of any Iron; it muſt have a proper Length if it is thick; or if it is ſhort, it muſt have a ſufficient Thinneſs. So ordinary or weak *Loadſtones* cannot fix a Pole in a thick ſhort Key, which yet they will do in a little Key. So in a ſhort thick Iron tapering, a *Loadſtone* may fix a Pole in the little End, when it cannot in the great End.

13. When Ignition, Hammering, or a *Loadſtone* cannot make fixed Poles, it muſt not be thought that it can do abſolutely nothing on ſuch Rods; for even then it may be found, that there is an Effect of Magnetiſm in them diſcernable enough otherwiſe, though not enough to make fixed Poles.

14. When you have the due Length for making of a fixed Pole, you will find the making one a fixed *North*, will conſequently render the other a fixed *South-Pole:* But if keeping the ſame Diameter of this Rod, you increaſe its Length enough, the making one End a fixed *North-Pole* will not neceſſarily make the other a fixed *South-Pole*, but leave it a mutable Pole. So if you by a like primary Operation make the ſecond End a fixed Pole, the firſt End will loſe its Fixity, and become mutable.

I ſay, there is a certain Length ſuited to every thickneſs of Iron; to leave one End mutable, while the other is fixed, and the thicker the Iron is, the greater is the Length.

15. If you farther increaſe the Length of the ſame Rod, you will attain ſuch Length, that when you have fixed a Pole on one End, and then go to fix the other End, the Fixity of the firſt will not be deſtroyed, and that End become mutable as before; but the Fixity of the firſt End will remain, and ſo you make both Ends two fixed *North-Poles*, or two fixed *South-Poles.* I ſay, the ſhorteſt Length (for there is no *Terminus* of the greateſt Length) for this is more in thick than in thin Iron.

16. The aforeſaid Lengths are leſs, according to the Strength of Magnetiſm; *ſc.* Ignition requires a greater Length than when a Rod is actuated by a *Loadſtone*, and a Rod touched with a ſtrong *Loadſtone* requires leſs Length than one touched with a weak one.

By Mr. Ballard, n. 246. p. 417.

V. 1. I cauſed 6 or 7 ſeveral Drills to be made before my Face, and the Bit or Point of every one became a *North-Pole*, only by hardening, before they ever came to be worked, either in Iron or any other Matter, ſo that I cannot ſuppoſe thoſe found in a Shop to have gotten their Polarity ſo much from their After-uſe as from their firſt Make.

2. That Pieces of plain Iron, in ſhape like Drills (that is, ſomething long and ſmall) do always change their Poles as they are inverted, the End downwards being ever the *N.* Pole, I find not always true: For though it hold generally in ſuch ſmall Pieces, and always (as far as I can yet find) in Pieces of any Bulk, as large Hammers, Anvils, Andirons, Bars of Windows, *&c.* yet I found ſeveral ſmall Pieces of Steel, ſuch as the Drills are made of, to have fixed Poles, one End *North* the other *South*, in whatever Poſtures I held them. Some of theſe very vigorous in ſuch their Polarity, others ſhewed plainly a Tendency to ſuch a Pole, rather than the other, yet ſo faintly, that it applied contrary to their Inclination (that is at the upper End, if it affected to draw the *South*, or the lower End, if the *North*:) They cauſed the Needle to ſtand *in Æquilibrio*, *Eaſt* and *Weſt*; the particular Inclination of one End ſeeming, in ſome Pieces, quite to conquer; in others, quite to hinder that more general Polarity they both acquire, by being either upward or downward. Yet this ſeems only to be found in ſmall Stems of Iron; the being either upward or downward always prevailing in Pieces of great Bulk.

3. I took my Knife which had been touched a quarter of a Year or more before, and proffering it to the Needle, it drew the *North-Pole*; which happened right for my Purpoſe. I whetted it briſkly on a dry dirty Threſhold, and being thin, it became very hot towards the Point, the Edge being whet away to a Wire, as they term it, I ſtruck the very Top, and Back towards the Top againſt the Ground, as I had done the Sides, to deſtroy and rub off, if I could, all the former Polarity, which was *Southward*: Then offering it again to the Needle, it drew the *South* End, and was quite changed. To confirm the thing, I touched the ſame Knife again with the *North-Pole* of my Load-ſtone, and it drew vigorouſly the *North* End of the Needle. I whetted it again ſtrongly in the ſame manner, and it changed again. This I repeated five or ſix times, and it ſtill changed by whetting, eſpecially on the Sides towards the Top of the Knife; the very Top and Back, which could not be whet to ſo great an Heat, retaining ſtill ſome Affection for that Pole the *Load-ſtone* had inclined them to. This I tried with a Knife of a thicker Blade; but I could not with my Hand whet it to that Heat, as to have the ſame Effect wrought upon, as my own; though I uſed ſuch Force as at laſt to break it in two.

4. I ſuppoſe that bare Drilling might be able to give a Polarity to a Drill, if it could be made indifferent, as well as Filing does, if the Drill be uſed ſo briſkly as to be made as hot as the File makes the Iron. And though a *South-Pole* given by the *Magnet* cannot be taken off by the Heat of a briſk Motion, as that of Drilling, which yet by the Experiment of my Knife ſeems ro be contradicted; yet perhaps the Heat may be great enough to produce a Polarity in an indifferent Piece of Iron, as may be done in little indifferent Drill-like Pieces of Steel, by Filing.

The Declination of the Needle, obſerved by Mr Ja. Cunningham, *n.* 264. *p.* 577.

5. Two Degrees to the Northward of the Line, the North Point of the Needle did incline 8 Degrees downwards; but as we went to Southward, it was inclined above 48 Degrees upward.

Magnetical Variations, near Briſtol, *by Capt.* Sa. Sturmy, *n.* 37. *p.* 726.

VI. 1. *An.* 1666. *Jan.* 13. In *Rownham* Meadows near *Briſtol*, by the Water-ſide, Capt. *Sturmy* took the following Obſervations,

☉ *Alt.*		*Magnetick Azimuth.*		☉ *Azim.*		*Variation Weſterly.*	
44°	20′	72°	00′	70°	38′	1°	22′
39	30	80	00	78	24	1	36
31	50	90	00	88	26	1	34
27	2	95	00	93	36	1	24
23	20	103	00	101	23	1	23

In this Table, he notes the greateſt Difference to be 14′, and taking the Mean for the true Variation, he concludes it then and there, to be juſt 1° 27′. He obſerved again in the ſame Day of the next Year, *viz.* *June* 13. 1667, and then he found the Variation encreaſed but 6 Weſterly.

At Paris, *by* M. Petit, *n.* 28. *p.* 527.

2. *An.* 1630. I traced 3 different *Meridian* Lines in ſeveral Places of *Paris*, and found, that the Needle declined 4½ deg. *North Eaſt*, which having publiſhed and made known here to the Curious, and to Artiſts, ſome of whom counted 9 or 10 degr. according to the Tradition and Writings of *Orontius Fineus*, and *Caſtle Franc*; others, 11½ deg. following *Sennertus* and *Offuſius*: all at firſt rejected my Obſervation, and as commonly new things meet with Obſtacles and Contradictions, before they are eſtabliſhed, thoſe that could not contradict what they ſaw, pretended that this Variety did perhaps proceed from the greater or leſſer Vigour in the Loadſtones employed to touch with, or from thence, that the Needles had been touched nearer to or farther from their Poles.

To remove the Objections, and to try another Quality which *Gilbert* had aſſigned to *Terella*'s, I cauſed a Magnet to be turned with the Powder of Emery, till it became a ſpherical half Inch in Diameter, its 3 Centers of Magnitude, Gravity and Strength being the ſame, with ſo much Juſtneſs, that after I had exactly found the two Poles of this Stone, I cauſed two ſmall Holes to be made therein, to ſupport it by two Points of Needles, as by two Pivots; which having put in a Meridian of Braſs, and ſuſpended the Ball betwixt them and a little Globe, it was ſo eaſily moveable, that I made it turn every way with a Blaſt only of my Mouth, and it ſtopped indifferently, now in one, then in another Place, not any ſide of it prevailing.

This Stone, being thus prepared without any Defect in Virtue or Figure, uniform, homogeneous, equilibrated, was adjuſted on its Meridian and an Horizon, and ſo placed on its Meridian Line, that the Poles thereof anſwered to the Poles of the Heavens. The Succeſs was that it had not any Motion at all: whence I thought the Propoſition of *Gilbert*, that ſuch a Stone ſo poſited would turn round in 24 Hours, was ſufficiently refuted.

This Stone, together with others (whereof the Poles were well marked) ſerved me alſo to find out, whether the Needles touched in different places, nearer to or farther from the Poles, had different Declinations. Which having tried frequently, I found no Difference at all in the Declination of the Needles, but all of them declined then from the Meridian 4½ deg. from the North-Eaſtward. I alſo found it to be the ſame in many places, from *Breſt* in *Britany* to the *Valtoline* amongſt the *Alps*. I believed at firſt, that the Antients had ill obſerved the Variation; but I was ſoon undeceived of this Error, by the Obſervations in *England*, of Mr. *Burrows*, *An.* 1580. of Mr. *Gunter*, *An.* 1612. and of Mr. *Gellibrand*, *An.* 1633. which did aſſure me, that thoſe Declinations were not conſtant.

And that I might be convinced by myſelf, in *June*, *An.* 1660, after I had very exactly traced a Meridian by many Azimuths, before and after Noon, with a Braſs Quadrant of 6 Foot Diameter, and applied good Needles upon it; the one of 7, the other of 10 Inches long, I found that they declined but one Degree, or thereabout: And the laſt Year (1666,) I found no more but 10 Minutes on the ſame Meridian. And methinks that the Declination this Year (1667,) is ſtill leſs, but yet ſome Minutes towards the Eaſt, at leaſt at *Paris*. But I doubt not but in 12 or 15 Years the Declination will be 1½ deg. *North-Weſt*: As I have prognoſticated by my Hypotheſis, which maketh the Declination to vary a Degree every 7 or 8 Years.

At Rome, by M. Adr. Auzout, n. 58. p. 1184.

3. *An.* 1670. M. *Adrian Auzout* made the following Obſervation here at *Rome*, on many meridian Lines, with a Needle about 6 Inches long, and on all the Lines it was ſeen to decline ſomewhat more than a deg. Weſtward, and on ſome near 2½ Degrees. But by the Obſervations here made formerly, it appears, that the Needle hath declined Eaſtward to 8 Degrees, and hath afterwards been diminiſhing, until it comes to the other part, where we find it at preſent.

It ſeems not, that this Difference of 10 deg. and more, can be attributed to the Change of the Pole of the Earth, or to the Magnet, or to the Iron, that are found in certain places, becauſe there is but little *Loadſtone*; and M. *Auzout* affirms, that the Mines which he hath ſeen, make no Impreſſion at all on the Needle, ſo that 'tis difficult to hit the true Cauſe of ſuch a Variation: Yet however, if the Direction of the Magnet, and of the Needle touched by it, depends upon the Flux of a certain Matter, paſſing through the whole Earth, or the exterior parts of it, ſtrait along the Axis, it may be ſaid, that it proceeds from Changes made in the ſaid Flux, which ſuppoſing the Inequalities of the Earth, and the Alterations made continually therein, as well artificial by Excavations, and ſuch like other Works, as natural by Corroſions, cauſed by Fire and Water, or by the Generation of Metals and Stones; beſides the various Changes we cannot think of, by reaſon of the little Knowledge we have of ſo vaſt a Body as the Earth, cannot but in progreſs of time change its Situation. The Inequalities of the Earth may in time occaſion ſome bending in the Current of this Magnetick Matter, and make it change its Bed and Channel; whence it comes to paſs, that the Needle changeth its Direction, according as the Current changeth which directs it. And if it ſhould be ſo, there would be no hopes of finding a regular Hypotheſis for that Change; foraſmuch as it would depend upon Cauſes that have no Regularity at all in them, as moſt of the Mutations of Nature are.

At Dantzick, *by Nr.* Hevelius, *n.* 64. *p.* 2059.

4. *An.* 1642. I obſerved the Declination of the Magnet here at *Dantzick*, as did M. *Linnemannus* about the ſame time at *Koningſberg*, and we both found the Magnetick Needle at that time to decline from the North 3 *deg.* 5 *min.* Weſtw. But now (*Jun.* 22. 1670. *S. N.*) it is far otherwiſe, for it declines at preſent, as I have very carefully obſerved, 7 *deg.* 20 *min.* to the ſame Quarter, ſo that in the ſpace of 28 Years, that Declination is increaſed 4 *deg.* 15 *min.* In the Year 1628, if I remember aright, I found it near 1 *deg.* Weſtw. which Declination was affirmed by the learned *Petrus Crugerus* (once my worthy *Præceptor*) to have been about the beginning of this Age, or the end of the next foregoing, 8 *deg.* 30 *min.* Eaſtw. Hence it appears, that this Declination of the *Loadſtone* doth here, at *Dantzick*, encreaſe each Year to 9 *min.* 6 *ſec.* which is ſufficiently confirmed by the obſervations made at *Lime-Houſe*, near *London*, by thoſe three famous *Engliſhmen*, *Burrows*, *Gunter*, and *Gellibrand*. Of whom the firſt found the Declination *An.* 1580. to be 11 *deg.* 16 *min.* the Second, 5 *deg.* 36 *min.* 30 *ſec.* *An.* 1662; the Third, 4 *deg.* 3 *min.* 30 *ſec.* *An.* 1634.

I cannot yet deviſe any cauſe of thoſe Appearances, except we impute them to a kind of Libration in the Motion of the Earth, and the Variation of the Meridian.

At Nuremberg *in* Germany, *by* Joh. Chr. Sturmius, *Ph. Col. n.* 2. *p.* 8.

5. The laſt Summer 1680, I was preſent with Dr. *Geo. Volcamer*, at *Nuremberg*, while he was making ſome Obſervations and Trials with his Magnetical Needle. He repeated the Trials ſeveral Days one after another, and with various ways of Examination, but ſtill in every of them, with the ſame Succeſs; he moſt certainly found, that the North End of the Magnetical Needle (which the former Age always reported to us, to vary from the North, and to direct or point more towards the Eaſt, by ſeveral Degrees) did now decline towards the Weſt near 5 Degrees.

M. G. C. Eimart, *n.* 178. *p.* 1253.

In the Year 1685, about the Beginning of *Auguſt*, having taken all imaginable Care to be ſure of our Meridians, we tried ſeveral Magnetick Needles, as well thoſe old ones we had made uſe of about five Years before, as many freſh ones, of a middling Length, the longeſt of which did not exceed half a Foot, but were ſlighter and more active; and what is ſtrange, we found the Declination of the Needle did not vary one Minute, but agreed exactly, in every Meridian with the former, that is, it was 5 *deg.* 5 *min.* to the Weſt. Whether it hath gone further in the mean time, or its Deviation be retrogade now, which indeed might happen by Chance, is not certain; for I am not willing to aſſert that, being rather inclined to think it hath been ſtationary at that Point, its Motion without doubt being circular.

7. *An.* 1683. the magnetical Variation here at *Cabo Corſe Caſtle*, was 3 *deg.* 49 *min.* from the North to the Weſtward.

On the Coaſt of Guinea, *by Mr* Heathcot *n.* 158. *p.* 578.

VII. Mr. *Henry Bond* having entertained an Hypotheſis of the Variations of the Needle, hath (for the Examination of it) calculated the following Table.

Magnetical Variations predicted by Mr. Henry Bond, *n.* 40. *p.* 789.

Years.	*Variation Weſt.*		*Years.*	*Variation Weſt.*		*Years.*	*Variation Weſt.*		*Years.*	*Variation Weſt.*	
1663	1°	56′	1701	7°	19′	1706	8°	1′	1711	8°	41′
1670	2	18	1702	7	28	1707	8	9	1712	8	49
1680	4	00	1703	7	36	1708	8	17	1713	8	56
1690	5	39	1704	7	45	1709	8	25	1714	9	4
1700	7	10	1705	7	53	1710	8	33	1715	9	11

VIII. Before I proceed to the Theory of the Variation of the Magnetical Compaſs, it is neceſſary to lay down the Grounds upon which I raiſe my Concluſions; and at once to give a Synopſis of thoſe Variations which I have reaſon to look upon as ſure, being moſtly the Obſervations of perſons of good Skill and Integrity.

Theory of the Magnetical Variation by Mr. Edm. Halley, *n.* 148. *p.* 208.

Names of Places.	*Long. from London.*	*Latitude.*	*An. Dom.*	*Variation obſerved.*
London	00 0′	51° 32′ N	1580	11° 15′ E
			1622	6 00 E
			1634	4 5 E
			1672	2 30 W
			1683	4 30 W
Paris	2 25 E	48 51 N	1640	3 00 E
			1666	0 00
			1681	2 30 W
Uraniburg	13 00 E	55 54 N	1672	2 35 W
Copenhagen	12 53 E	55 41 N	1649	1 53 E
			1672	3 45 W
Dantzick	19 00 E	54 23 N	1679	7 00 W
Mompelier	4 00 E	43 37 N	1674	1 10 W
Breſt	4 25 W	48 23 N	1680	1 45 W
Rome	13 00 E	41 50 N	1681	5 00 W

Bayonne	1 20 W	43 30 N	1680	1 20 W
Hudſon's Bay	79 40 W	51 00 N	1668	19 15 W
In *Hudſon's Streights*	57 00 W	61 00 N	1668	29 30 W
In *Baffin's Bay* at Sir *Tho. Smith's* (*Sound*	80 00 W	78 00 N	1616	57 00 W
At Sea	57 00 W	38 40 N	1682	7 30 W
At Sea	31 30 W	43 50 N	1682	5 30 W
At Sea	12 00 W	21 00 N	1678	0 40 E
Cape St. *Auguſtine* off *Braſil*	35 30 W	28 00 S	1670	5 30 E
Cape *Frio*	41 10 W	22 40 S	1670	12 10 E
At Sea off of the Mouth of the River of *Plata*	53 00 W	39 30 S	1670	20 30 E
At the Eaſt Entrance of the *Magellan Streights*	68 00 W	52 30 S	1670	17 00 E
At the Weſt Entrance of the *Magellan Streights*	75 00 W	53 00 S	1670	14 10 E
Baldivia	73 00 W	40 00 S	1670	8 10 E
At Cape *d'Agulhas*	16 30 E	34 50 S	1622	2 00 W
			1675	8 00 W
At Sea	1 00 E	34 30 S	1675	0 00
At Sea	20 00 W	34 00 S	1675	10 30 E
At Sea	32 00 W	24 00 S	1675	10 30 E
At St. *Helena*	6 30 W	16 00 S	1677	0 40 E
At *Aſcenſion*	14 30 W	7 50 S	1678	1 00 E
At *Johanna*	44 00 E	12 15 S	1675	19 30 W
At *Mombaſa*	40 00 E	4 00 S	1675	16 00 W
At *Zocatra*	56 00 E	12 30 N	1674	17 00 W
At *Aden*, at the M. of the *R. Sea*	47 30 E	13 00 N	1674	15 00 W
At *Diego Roiz*	61 00 E	20 00 S	1676	20 30 W
At Sea	64 30 E	0 00 S	1676	15 30 W
At Sea	55 00 E	27 00 S	1676	24 00 W
At *Bombay*	72 30 E	19 00 N	1676	12 00 W
At Cape *Comorin*	76 00 E	8 15 N	1680	8 48 W
At *Ballaſore*	87 00 E	21 30 N	1680	8 10 W
At Fort St. *George*	80 00 E	13 15 N	1680	8 10 W
At the Weſt point of *Java*	104 00 E	6 40 S	1676	3 10 W
At Sea	58 00 E	39 00 S	1677	27 30 W
At the Iſle of St. *Paul*	72 00 E	38 00 S	1677	23 30 W
At *Van Diemen's Land*	142 00 E	42 25 S	1642	0 00
At *New Zealand*	170 00 E	40 50 S	1642	9 00 E
At 3 *Kings Iſle* in *New Zealand*	169 30 E	34 35 S	1642	8 40 E
At the Iſle *Roterdam* in the *S. Sea*	184 00 E	20 15 S	1642	6 20 E
On the Coaſt of *New Guinea*	149 00 E	4 30 S	1643	8 45 E
At the Weſt point of *New Guinea*	126 00 E	0 26 S	1643	5 30 E

By this Table it appears,

Firſt, That in all *Europe* the Variation at this Time is Weſt, and more in the Eaſtern Parts thereof than the Weſtern; as likewiſe that it ſeems throughout to be upon the Increaſe that way.

2. That on the Coaſt of *America*, about *Virginia*, *New England*, and *Newfoundland*, the Variation is likewiſe weſterly; and that it increaſes all the way as you go northerly along the Coaſt, ſo as to be above 20 *deg.* at *Newfoundland*, nearly 30 *deg.* in *Hudſon*'s *Streights*, and not leſs than 57 *deg.* in *Baffin*'s Bay; alſo that as you ſail Eaſtwards from this Coaſt, the Variation diminiſhes. From theſe two it is a *Legitimate Corollary*, That ſomewhere between *Europe* and the North Part of *America*, there ought to be an eaſterly Variation, or at leaſt no weſterly; and ſo I conjecture it's about the eaſtermoſt of the *Tercera* Iſlands.

3. That on the Coaſt of *Braſil* there is Eaſt Variation, which increaſes very notably as you go to the Southward, ſo as to be 12 *deg.* at Cape *Frio*, and over-againſt the River of *Plata* 20½ *deg.* and from thence, ſailing Southweſterly to the *Streights* of *Magellan*, it decreaſes to 17 *deg.* and at the Weſt Entrance it is but 14 *deg.*

4. That to the Eaſtward of *Braſil* properly ſo called, this eaſterly Variation decreaſes, ſo as to be very little at St. *Helena* and *Aſcenſion*; and to be quite gone, and the Compaſs to point true about 18 *deg.* of Longitude, Weſt from the Cape of *Good Hope*.

5. That to the Eaſtward of the aforeſaid Places, a Weſtward Variation begins, which reigns in the whole *Indian Sea*, and ariſes to no leſs than 18 *deg.* under the *Æquator* itſelf, about the Meridian of the Northern Part of *Madagaſcar*, and near the ſame Meridian; but in 39 *deg.* South Latitude, it is found full 27½ *deg.* from thence eaſterly, and Weſt Variation decreaſes, ſo as to be but little more than 8 *deg.* at Cape *Comorin*, and then 3 *deg.* upon the Coaſt of *Java*, and to be quite extinct about the *Molucca* Iſlands, as alſo a little to the Weſtwards of *Van Diemen*'s Land, found out by the *Dutch* in 1642.

6. That to the Eaſtward of the *Molucca*'s and *Van Diemen*'s Land in South Lat. there ariſes another eaſterly Variation, which ſeems not ſo great as the former, nor of ſo large Extent; for that at the Iſland *Roterdam* it is ſenſibly leſs than upon the Eaſt-Coaſt of *New Guinea:* and at the rate it decreaſes, it may well be ſuppoſed, that about 20 *deg.* farther Eaſt, or 25 *deg.* Eaſt Long. from *London*, in the Latitude of 20 *deg.* South, a weſterly Variation begins.

7. That the Variations obſerved by the Hon. Sir *John Narborough*, at *Baldivia*, and at the Weſt Entrance of the *Streights* of *Magellan*, do plainly ſhew, that the Eaſt Variation noted in our 3d Remark is decreaſing apace, and that it cannot reaſonably extend many Degrees into the *South Sea* from the Coaſt of *Peru* and *Chili*, leaving room for a ſmall weſterly Variation in that Tract of the unknown World, that lies in the Mid-way between *Chili* and *New Zealand*, and between *Hound*'s Iſland and *Peru*.

8. That in ſailing North-weſt from St. *Helena*, by *Aſcenſion*, as far as the *Æquator*, the Variation continues very ſmall Eaſt, and as it were conſtantly

the ſame: So that in this part of the World, the Courſe wherein there is no Variation, is evidently no Meridian, but rather Northweſt.

9. That the Entrance of *Hudſon*'s *Streights* and the Mouth of the *River of Plata*, being nearly under the ſame Meridian, at the one Place the Needle varies 29½ *deg.* to the Weſt, at the other 20½ *deg.* to the Eaſt. This plainly demonſtrates the Impoſſibility of reconciling theſe Variations by the Theory of *Bond*; which is by two Magnetical Poles and an Axis, inclin'd to the Axis of the Earth; from whence it would follow that under the ſame Meridian, the Variation ſhould be in all Places the ſame way.

Theſe things being premiſed, may ſerve as a ſure Foundation for this Theory, That *the whole Globe of the Earth is one great Magnet, having* 4 *Magnetical Poles, or Points of Attraction, near each Pole of the* Æquator, and that *in thoſe Parts of the World which lie near adjacent to any of thoſe Magnetical Poles, the Needle is governed thereby; the neareſt Pole being always predominant over the more remote.* The Parts of the Earth wherein theſe Magnetical Poles lie, cannot as yet be exactly determined for want of ſufficient *Data* to proceed geometrically: But as near as Conjecture can reach, I reckon that the Pole which is at preſent neareſt to us, lies in or near the Meridian of the *Land's End of England*, and not above 7 *deg.* from the Pole Arctick. By this Pole the Variations in all *Europe* and *Tartary*, and the *North-Sea*, are principally governed, yet with regard to the other Northern Pole, whoſe Situation is in a Meridian paſſing about the middle of *California*, and about 15 *deg.* from the North Pole of the World. To this the Needle has chiefly reſpect in all the *North-America*, and in the two Oceans on either Side thereof, from the *Azores* weſtwards to *Japan*, and farther. The two Southern Poles are rather farther diſtant from the South Pole of the World: The one about 16 *deg.* therefrom, is in a Meridian ſome 20 *deg.* to the Weſtward of *Magellan*'s *Streights*, or 95 *deg.* Weſt from *London*; this commands the Needle in all the *South-America*, in the *Pacific Sea*, and the greateſt part of the *Ethiopic Ocean*. The 4th and laſt Pole ſeems to have the greateſt Power and largeſt Dominions of all, as it is the moſt remote from the Pole of the World, being little leſs than 20 *deg.* diſtant therefrom, in the Meridian which paſſes through *Hollandia Nova*, and the Iſland of *Celebes*, about 120 *deg.* Eaſt from *London*. This Pole is predominant in the South part of *Africa*, in *Arabia*, and the *Red-Sea*, in *Perſia*, *India*, and its Iſlands, and all over the *Indian Sea* from the *Cape of Good Hope* Eaſtwards to the middle of the great *South-Sea* that divides *Aſia* from *America*. This ſeems to be the preſent Diſpoſition of the Magnetical Virtue throughout the whole Globe of the Earth.

By this Hypotheſis it is plain that (our *European* North Pole being in the Meridian of the *Land's End of England*) all Places more Eaſterly than that will have it on the Weſt-ſide of the Meridian; and conſequently the Needle reſpecting it with its Northern Point, will have a Weſterly Variation, which will ſtill be greater as you go to the Eaſtwards, till you come to ſome Meridian of *Ruſſia*, where it will be greateſt, and from thence decreaſe again. Thus at *Breſt* the Variation is but 1½ *deg.* at *London* 4½ *deg.* but at *Dantzick* 7 *deg.* Weſt. To the Weſtward of the Meridian of the *Land's End*, the Needle ought to have an Eaſterly Variation, were it not that (by approaching the *American Northern Pole*, which lies on the *Weſt*-ſide of the Meridian, and ſeems to be of greater Force than this other) the Needle is drawn thereby Weſtward, ſo as to counterbalance the Direction given by the *European Pole*, and to make a ſmall *Weſt* Variation in the Meridian of the *Land's End* itſelf. Yet I ſuppoſe that about the Meridian of the Iſle *Tercera*, our neareſt Pole may ſo far prevail as to give the Needle a little turn to the *Eaſt*, though but for a very ſmall Space, the Counterbalance of thoſe two *Poles* permitting no conſiderable Variation in all the Eaſtern Parts of the *Atlantick Ocean*, nor upon the *Weſt* Coaſts of *England* and *Ireland*, *France*, *Spain* and *Barbary*. But to the Weſtwards of the *Azores*, the power of the *American Pole* overcoming that of the *European*, the Needle has chiefly reſpect thereto; and turns ſtill more and more towards it as you approach it. Whence it comes to paſs, that on the Coaſt of *Virginia*, *New-England*, *Newfoundland*, and in *Hudſon*'s *Streights*, the Variation is Weſtwards; that it decreaſes as you go from thence towards *Europe*; and that it is leſs in *Virginia* and *New-England* than in *Newfoundland*, and *Hudſon*'s *Streights*. This Weſterly Variation again decreaſes, as you paſs over the *North America*; and about the Meridian of the Middle of *California*, the Needle again points due *North*; and from thence Weſtwards to *Yedzo*, and *Japan*, I make no doubt but the Variation is Eaſterly; and half Sea over not leſs than 15 *deg*. This *Eaſt* Variation extends over *Japan*, *Yedzo*, *Tartary*, and part of *China*, till it meet with the Weſterly, which is governed by the *European North-Pole*, and which I ſaid was greateſt ſomewhere in *Ruſſia*.

Towards the *Southern-Pole* the Effect is much the ſame, only that here the *South* point of the Needle is attracted. Hence it will follow, that the Variation on the Coaſt of *Brazil*, at the River of *Plata*, and ſo on to the *Streights* of *Magellan*, ſhould be Eaſterly, as in the 3d Remark. And this Eaſterly Variation doth extend Eaſtward over the greateſt part of the *Ethiopick Sea*, till it be counterpoiſed by the Virtue of the *Southern-Pole*; as it is about mid-way between the *Cape of Good-Hope*, and the Iſles of *Triſtan d' Alcunha*. From thence Eaſtwards the *Aſian South-Pole* (as I muſt take the liberty to call it) becoming prevalent, and the *South* point of the Needle being attracted thereby, there ariſes a *Weſt* Variation very great in Quantity and Extent, becauſe of the great Diſtance of this Magnetical *Pole* from the *Pole* of the World. Hence it is, that in all the *Indian Sea* as far as *Hollandia nova*, and farther, there is conſtantly *Weſt* Variation: And that under the *Equator* itſelf, it ariſes to no leſs than 11 *deg*. where it is moſt. About the Meridian of the Iſland *Celebes*, being likewiſe that of this Pole, this Weſterly Variation ceaſes, and an Eaſterly begins; which reaches, according to my Hypotheſis, to the Middle of the *South-Sea* between *Zelandia Nova* and *Chili*, leaving room for a ſmall *Weſt* Variation governed by the *American South-Pole*; which I ſhewed to be in the *Pacifick Sea*, in the 6th and 7th Remarks.

In the *Torrid Zone*, and particularly under the *Equinoctial*, reſpect muſt be had to all 4 Poles, and their Poſitions well conſidered; otherwiſe it will not be eaſy to determine what the Variation ſhall be, the neareſt Pole being always the ſtrongeſt; yet not ſo, as not to be counterbalanced ſometimes by the united Forces of two more remote. A notable Inſtance hereof is in our 8th Remark, where I took notice, that in ſailing from St. *Helena*, by the Iſle of *Aſcenſion*, to the *Equator* on a N. W. Courſe, the Variation is very little Eaſterly, and in that whole Tract unalterable: For which I give this Reaſon, that the *South American Pole* (which is conſiderably the neareſt in the aforeſaid Places) requiring a great Eaſterly Variation, is counterpoiſed by the contrary Attraction of the *North American* and the *Aſian South-Poles*; each whereof ſingly is, in theſe Parts, weaker than the *American South-Pole:* And upon the N. W. Courſe, the Diſtance from this latter is very little varied; and as you recede from the *Aſian South-Pole* the Balance is ſtill preſerved by the Acceſs towards the *North American-Pole*. I mention not in this Caſe the *European North-Pole*, its Meridian being little removed from thoſe of theſe Places, and of itſelf requiring the ſame Variations we here find.

n.195.p.564. What I have here ſaid does plainly ſhew the ſufficiency of this Hypotheſis, ſolving the Variations that are at this time obſerved.

But there are two Difficulties not eaſy to ſurmount. The one is, That no *Magnet* I have ever ſeen or heard of, hath more than two oppoſite Poles: Whereas the Earth hath viſibly four, and perhaps more. Secondly, It is plain by the change of the Variation, not only at *London*, where this Diſcovery was firſt made, but alſo almoſt all over the Earth; that theſe Poles are not, at leaſt all of them, fixed in the Earth, but ſhift from Place to Place, whereas it is not known that the Poles of the *Loadſtone* ever ſhifted their Place in the Stone, nor, conſidering the compact Hardneſs of that Subſtance, can it eaſily be ſuppoſed. Theſe Difficulties for a long time made me deſpond, when in accidental Diſcourſe, and leaſt expecting it, I ſtumbled on the following Hypotheſis.

It is ſufficiently known and allowed, that the Needle's Variation changes; and that this Change is gradual and univerſal, will appear by the following Examples.

At *London*, *An.* 1580 The Variation was obſerved by Mr. *Burrows*, to be 11 *deg.* 15 *min.* Eaſt. In *An.* 1622, the ſame was found by Mr. *Gunter*, to be but 6 *deg.* Eaſt. In the Year 1634, Mr. *Gellibrand* found it 4 *deg.* 5 *min.* Eaſt. In 1657, Mr. *Bond* obſerved that there was no Variation at *London*. *An.* 1672, myſelf obſerved it 2 *deg.* 30 *min.* to the Weſt; and this preſent Year 1692, I again found it 6 *deg.* Weſt. So that in 112 Years the Direction of the Needle has changed no leſs than 17 Degrees.

At *Paris*, *Orontius Finæus* about the Year 1550, did account it about 8 or 9 *deg.* Eaſt Variation. *An.* 1640, it was found 3 *deg.* Eaſt. *An.* 1666, there was no Variation there, and *An.* 1681, I found it to be 2 *deg.* 3 *min.* to the Weſt.

At Cape *d' Agulhas*, the moſt Southerly Promontory of *Africa*, about the Year 1600, the Needle pointed due North and South without Variation, whence the *Portugueze* gave its Name. *An.* 1622, there was 2 *deg.* Weſt Variation. *An.* 1675, it was 8 *deg.* Weſt: And this Year 1692, it was curiouſly obſerved not leſs than 11 *deg.* Weſt.

At St. *Helena*, about the Year 1600, the Needle declined 8 *deg.* to the Eaſt. *An.* 1623, it was but 6 *deg.* Eaſt. *An.* 1677, when I was there, I obſerved it accurately on Shore to be 40 *min.* Eaſt; and now this Year it was found 1 *deg.* to the Weſtward of the North.

At Cape *Comorin* in *India*, in the Year 1620, there was 14 *deg.* 20. *min.* Weſt Variation; in the Year 1680, there was 8 *deg.* 48. *min.* but in the Year 1688, it was no more than 7 *deg.* 30 *min.* ſo that here the Needle has returned to the Eaſt, about 7 *deg.* in 70 Years.

From theſe, and many other Obſervations, it is evident that the Direction of the Needle is in no Place fixed and conſtant, though in ſome it changes faſter than in others. And where for a long time it has continued as it were unaltered, it is there to be underſtoud, that the Needle has its greateſt Deflection, and is become Stationary, in order to return, like the Sun in the *Tropick.* This at preſent is in the *Indian Sea*, about the Iſland *Mauritius*, where is the higheſt Weſt Variation, and in a Tract tending from thence into the N.N.W. towards the *Red Sea* and *Egypt.* And in all Places to the Weſtward of this Tract, all over *Africa* and the Seas adjoining, the Weſt Variation will be found to have increaſed; to the Eaſtwards thereof, as in the Example of Cape *Comorin*, to have decreaſed, *viz.* all over the *Eaſt-Indies*, and the Iſlands near it.

After the like manner, in that Space of Eaſt Variation, which, beginning near St. *Helena*, is found all over the *South America*, and which at preſent is higheſt about the Mouth of *Rio de la Plata*, it has been obſerved, that in the Eaſtern Parts thereof the Variation of the Needle gradually decreaſes. And by Analogy we may infer, though we have not Experience enough to aſcertain it, that both the Eaſt and Weſt Variation in the *Pacifick Sea*, do gradually increaſe and decreaſe after the ſame Rule.

Theſe *Phænomena* being well underſtood, and duly conſidered, do ſufficiently evince, that the whole Magnetical Syſtem is by one, or perhaps more Motions tranſlated: That this moving thing is very great, as extending its Effects from Pole to Pole; and that the Motion thereof is not *per ſaltum*, but by a gradual and regular Motion.

Now conſidering the Structure of our terraqueous Globe, the only Way to render this Motion intelligible and poſſible, is, to ſuppoſe it poſſible to turn about the Center of the Globe, having its Center of Gravity fixed and immoveable in the ſame common Center of the Earth: And there is yet required, that this moving internal Subſtance be looſe, and detached from the external Parts of the Earth whereon we live. So then the external Parts of the Globe may well be reckoned as the Shell, and the internal as a *Nucleus* or inner Globe included within ours, with a fluid Medium between. Which having the ſame common Center and Axis of diurnal Rotation, may turn about with our Earth each 24 Hours; only this outer Sphere having its turbinating Motion, ſome ſmall matter either ſwifter or ſlower than the internal Ball, and a very minute Difference in length of Time, by many Repetitions becoming ſenſible, the internal Parts, will, by Degrees, recede from the external, and not keeping pace with one another, will appear gradually to move either Eaſtwards or Weſtwards by the Difference of their Motions. So that if this exterior Shell of Earth be a Magnet, having its Poles at a Diſtance from the

Poles

Poles of Diurnal Rotation; and if the internal *Nucleus* be likewiſe a *Magnet*, having its Poles in two other Places diſtant from the Axis, and theſe latter by a gradual and ſlow Motion change their Place in reſpect of the external, we may then give a reaſonable Account of the four Magnetical Poles, as likewiſe of the Changes of the Needle's Variations, which, till now, hath been unattempted.

The Period of this Motion being wonderful great, and there being hardly an Hundred Years ſince theſe Variations have been duely obſerved, it will be very hard to bring this Hypotheſis to a *Calculus*, eſpecially ſince, though the Variations do increaſe and decreaſe regularly in the ſame Place, yet in different Places, at no great Diſtance, there are found ſuch caſual Changes thereof, as can no ways be accounted for by a regular Hypotheſis; as depending upon the unequal and irregular Diſtribution of the Magnetical Matter within the Subſtance of the external Shell or Coat of the Earth: which Defect, the Needle from the Poſition, it would acquire from the Effect of the general Magnetiſm of the whole. Of this the Variation at *London* and *Paris* gave a notable Inſtance: For the Needle has been conſtantly about 1°½ more Eaſterly at *Paris* than at *London*, though it be certain, according to the general Effect, the Difference ought to be the contrary Way. Notwithſtanding which the Variations in both Places do change alike. Hence, and from ſome other of like Nature, I conclude, That the two Poles of the external Globle are fixed in the Earth, and that if the Needle were wholly governed by them, the Variations thereof would be always the ſame with ſome little Irregularities upon the Account I but juſt now mentioned: But the internal Sphere having ſuch a gradual Tranſlation of its Poles, does influence the Needle, and direct it variouſly, according to the Reſult of the Attractive or Directive Power of each Pole, and conſequently there muſt be a Period of the Revolution of this internal Ball, after which the Variation will return again as before.

If then two of the Poles be fixed, and two moveable, I think we may determine that the *European* Pole is that which is moveable of the two *Northern Poles*, and that has chiefly influenced the Variations in theſe Parts of the World: For in *Hudſon*'s *Bay*, which is under the Direction of the *American* Pole, the Change is not obſerved to be near ſo faſt as in theſe Parts of *Europe*, though the Pole be much farther removed from the Axis: And that the *Aſian*, of the 2 *South-Poles*, is fixed, and conſequently the *American* moveable; from the like Obſervation of the ſlow Decreaſe of the Variation on the Coaſt of *Java*, near the Meridian of the *Aſian* Pole.

If this be allowed me, it is plain that this Motion is Weſtwards, and by Conſequence that the aforeſaid *Nucleus* has not preciſely attained the ſame Degree of Velocity with the exterior Parts in their Diurnal Revolution: But ſo very nearly equals it, that in 365 Revolves the Difference is ſcarce ſenſible. This I conceive to ariſe from the Impulſe, whereby this Diurnal Motion was impreſs'd on the Earth, being given to the external Parts, and from thence in Time commuicated to the internal.

The Period of this Motion appears, by all Circumſtances, to be of many Centuries of Years; and conſidering the Change of the Place, where there was no Variation, by reaſon of the *Æquilibre* of the two Southern magnetical Poles, *viz.* from Cape *d'Agulhas* to the Meridian of St. *Helena*, (which is about 23° in about 90 Years) and of the Place where the Weſterly Variation is in its ἀκμὴ or greateſt Deflection, being about half ſo much, *viz.* from the Iſle of *Diego Roiz* to the South-Weſt Parts of *Madagaſcar*; we may with ſome Reaſon conjecture, that the *American* Pole was moved Weſtwards 46° in that Time; and that the whole Period thereof is performed in ſeven Hundred Years, or thereabouts: So that the nice Determination of this, and of ſeveral other Particulars in the Magnetick Syſtem, is reſerved for remote Poſterity.

I doubt not but this Hypotheſis of an Internal *Nucleus* will find Oppoſers enough: But the Globe of *Saturn* being environed with his Ring, is a notable Inſtance of this Kind, as having the ſame common Centre, and moving along with it, without ſenſibly approaching one Side of it more than another: And if this Ring were turned on one of its Diameters, it would then deſcribe ſuch a Concave Sphere as I ſuppoſe our External one to be. And ſince the Ring in any Poſition given, would in the ſame manner keep the Centre of *Saturn* in its own, it follows that ſuch a Concave Sphere may move with another included in it, having the ſame common Centre. Nor can it well be ſuppoſed otherwiſe, conſidering the Nature of Gravity: For ſhould theſe Globes be adjuſted once to the ſame common Centre, the Gravity of the Parts of the Concave would preſs equally towards the Centre of the internal Ball, which Equality muſt neceſſarily continue till ſome external Force diſturb it; which is not eaſy to imagine in our Caſe. This perhaps I might more intelligibly expreſs, by ſaying, that the inner Globe being poſited in the Centre of the exterior, muſt neceſſarily aſcend, whatſoever Way it move; that is, it muſt overcome the Force of Gravity preſſing towards the common Centre, by an Impulſe it muſt receive from ſome outward Agent: But all outward Efforts being ſufficiently fenced againſt, by the Shell that ſurrounds it, it follows, that this *Nucleus* being once fixed in the common Centre, muſt always there remain.

It may be objected, That the Water of the Sea would perpetually leak through this Shell, unleſs we ſuppoſe the Cavity full of Water: But when we conſider how tightly great Beds of Chalk or Clay, and much more Stone, do hold Water, and even Caves arched with Sand, no Man can doubt but the Wiſdom of the Creator has provided for the *Macrocoſm*, by many other Ways than I can either imagine or expreſs. We cannot think it a hard Suppoſition that the internal Parts of this Bubble of Earth ſhould be replete with ſuch Saline and Vitriolick Particles as may contribute to Petrefaction, and diſpoſe the tranſuding Water to ſhoot and coagulate into Stone, ſo as continually to fortify, and if need were, to conſolidate any Breach or Flaw in the Concave Surface of the Shell. And this perhaps may, not without Reaſon, be ſuppoſed to be the final Cauſe of the Admixture of the Magnetical Matter in the Maſs of the terreſtrial Parts of our Globe, *viz.* To make good and maintain the Concave Arch of this Shell: For by what the excellent Mr. *Newton* has ſhewn, in his *Principia Philoſophiæ*, it will follow, That according to the general Principle of Gravity, viſible throughout the whole Univerſe, all thoſe Particles that by length of Time, or otherwiſe, ſhall moulder away, or become looſe on the Concave Surface of the external Sphere, would fall in, and with great Force deſcend on the Internal, unleſs thoſe Particles were of another ſort of Matter capable, by their ſtronger Tendency to each other, to ſuſpend the Force of Gravity; but we know no other Subſtances capable of ſupporting each other by their mutual Attraction, but the Magnetical; and theſe we ſee miraculouſly to perform that Office, even where the Power of Gravity has its full Effects much more within the Globe where it is weaker. Why then may we not ſuppoſe theſe ſaid Arches to be lined throughout with a Magnetical Matter, or rather to be one great Concave Magnet, whoſe two Poles are the Poles we have before obſerved to be fixed in the Surface of our Globe?

Another Argument favouring this Hypotheſis, is drawn from a Propoſition of the ſame Mr. *Newton*, where he determines the Force wherewith the Moon moves the Sea in producing the Tides: His Words are, *Denſitas* Lunæ *eſt ad Denſitatem* Terræ *ut* 680 *ad* 387, *ſeu* 9 *ad* 5, *quam proxime. Eſt igitur Corpus* Lunæ *denſius*, *ac magis* terreſtre *quam* Terra noſtra. Now if the Moon be more ſolid than the Earth as 9 to 5, why may not we reaſonably ſuppoſe, the Moon being a ſmall Body, and a ſecondary Planet, to be ſolid Earth, Water and Stone, and this Globe to conſiſt of the ſame Materials, only 4 Ninths thereof to be Cavity, within and between the internal Sphere, which I would render not improbable?

It muſt be allowed indeed, that theſe included Globes can be of very little Service to the Inhabitants of this outward World, nor can the Sun be ſerviceable to them either with his Light or Heat: But ſince we ſee all the Parts of the Creation abound with Animate Beings, why ſhould we think it ſtrange that the prodigious Maſs of Matter, whereof this Globe does conſiſt, ſhould be capable of ſome other Improvements, than barely to ſerve to ſupport its Surface? Why may we not rather ſuppoſe that the exceeding ſmall Quantity of ſolid Matter in reſpect to the fluid *Æther*, is ſo diſpoſed by the Almighty Wiſdom, as to yield as great a Surface for the Uſe of Living Creatures, as can conſiſt with the Conveniency and Security of the whole?

And though without Light there can be no living, yet there are many Ways of producing Light which we are wholly ignorant of: The Medium itſelf may be always luminous after the manner of our *Ignes fatui*; the Concave Arches may in ſeveral Places ſhine with ſuch a Subſtance as inveſts the Surface of the Sun; nor can we without a Boldneſs unbecoming a Philoſopher, adventure to aſſert the Impoſſibility of peculiar Luminaries below, of which we have no ſort of Idea.

Thus I have ſhewed a Poſſibility of a much more ample Creation, than has hitherto been imagined: A Notion till hitherto not ſo much as ſtarted in the World, and of which we could have no Intimation from any other of the *Phænomena* of Nature.

But there may be a farther Uſe of this Cavity of the Earth; *viz.* to diminiſh the ſpecifick Gravity thereof in reſpect of the Moon: For I think I can demonſtrate that the Oppoſition of the *Æther* to the Motions of the Planets in long Time becomes ſenſible, and conſequently the greater Body muſt receive a leſs Oppoſition than the ſmaller, unleſs the ſpecifick Gravity of the ſmaller do proportionably exceed that of the greater, in which Caſe only they can move together. So that the Cavity I aſſign in the Earth, may well ſerve to adjuſt its Weight to that of the Moon: For otherwiſe the Earth would leave the Moon behind it, and ſhe become another Primary Planet.

An invariable Compaſs; By M. de la Hire, *n.* 188. *p.* 344.

IX. 1. Having determined as well as I could the *South-Pole* of a *Terella*, or ſpherical *Loadſtone*, of 3 Inches Diameter, which accidentally had fallen into my Hands, I was much ſurprized to find it 18° diſtant from a Croſs, deep engraven on the Stone, which according to all appearance had heretofore been the Pole of this Stone, as it had been obſerved by him that cut it. This Change having revived ſome Thoughts I had formerly entertained concerning the Variation of the Needle, I believed that if it were true that the Poles of the Magnetical Virtue changed in the *Loadſtone*, as we ſee they change in the Earth, one might derive great Advantages therefrom: For if this Change of theſe Poles in the *Loadſtone* were certain, and that it was analogous to the Change of the Poles of the magnetick Virtue in the Earth, it is not to be doubted but a *Terella*, being ſuſpended at liberty, would remain immoveable, and that one Point thereof would regard the Pole of the World, which might be called the true Pole of the Stone, whilſt the Poles of its Virtue would paſs ſucceſſively from one part to another, after the ſame manner as they change in the Earth.

After having well conſidered this Hypotheſis, and having cleared up ſome Doubts which I had, concerning the Poſition of the Stone at the time when its Pole had formerly been determined, I concluded that this former Pole was diſtant from the Point I call the true Pole, 13 Degrees towards the Eaſt, in the Place where it had been marked (and which is unknown to me) ſince that at this time in this Country the Needle varies about 5 deg. Weſtward.

Upon this Hypotheſis, which I know not that any one elſe has yet thought upon, I have invented a new ſort of Needle for the Compaſs, which may have the ſame Alterations as a ſpherical *Loadſtone*, and at the ſame time the ſame Conveniencies as the other Needle hath.

I cauſed a Ring of 3 Inches Diameter to be made of Steel-Wire; from which there went 3 Radii of very fine Braſs-Wire meeting at the Center in a Cup perfectly like that of an ordinary Compaſs, that ſo this Circle might reſt on a Pin in its Center, and be at full Liberty to turn round, its Center being fixed. This done, I gave the magnetical Touch to this Steel Ring, by applying indifferently to a Point thereof, one of the Poles of a ſtrong *Loadſtone*, and the other Pole of the Stone to the oppoſite Point, to give the greater Virtue to the Ring. Then I obſerved that the Ring was ſtrongly magnetical, and that the Point called the South Pole did readily turn itſelf towards the North, and after ſeveral Vibrations ſtopped there, and that it had alſo the ſame Inclination towards the Pole, which is found in Needles after they have been touched: Laſtly, I fixed upon the Ring a ſmall *Fleur de Lis* of Braſs in the Point, which exactly reſpected the North, the Ring being firſt well ſettled.

To inform myſelf, if a Steel Ring had the ſame Effects as a *Terella*, I made the following Experiment. Having touched a Steel Ring, and having laid it on a Paper, I ſtrewed the Filings of Steel upon it; and then gently ſhaking the Paper, I ſaw that the Direction of the magnetical Matter paſſed directly croſs the Ring from one Pole to the other, and that there were two Vortices on the ſides, as it is obſerved in the ſpherical Magnet, which ſeems very ſurprizing; for according to the ordinary Hypotheſis of the Magnet, the magnetical Virtue paſſing more eaſily in the Steel than in the Air, ſhould run on both ſides of the Pole round the Ring, and only form a Pole oppoſite to the firſt. But I was further confirmed in this Opinion, by applying a flat and pointed Piece of Iron like the Blade of a Knife, to a *Loadſtone*, ſo as the Point of the Iron reached beyond the Stone; and having afterwards preſented this Point to the magnetical Ring, I obſerved that different Points of the Ring did apply to the Point of the Iron, according as the ſeveral Points thereof had been applied to the Stone; which happens not in the magnetical Needle, for that always preſents one of its Ends to the Point of the Iron, being not diſpoſed, by reaſon of its Length, to receive the magnetical Matter in all the Parts thereof analogous to thoſe of the Stone: It muſt only be noted, that in an irregular Stone, the magnetical Virtue appears ſtronger towards the Angles than in the other Parts; which may cauſe ſome Irregularity in this Experiment, if it be tried with a Stone that is very uneven.

Thoſe Experiments gave me the Curioſity of making another, by touching two Semicircles of Steel. Having joined the two Ends, touched by the ſame Poles, I obſerved by the Steel-Duſt the ſame Effect as in the Ring; but having joined the Ends differently touched, I found that immediately the two half Rings run together, and ſtuck to each other; and by the Steel-Duſt ſtrowed on Paper, I obſerved, that there were 4 Vortices, one in the middle of each Semicircle, and one at each of the Places where they were joined, and that the 2 latter were leſs than the others, and much ſtronger. I ſaw likewiſe, that there were 4 Poles, each of which was within a Vortex, and that each retained in its Semicircle the Virtue of the Ends of the half Rings.

I tried, after having touched a Steel Wire that was ſtraight, to make a Ring thereof. But I found that it had quite loſt its Virtue, which cannot be attributed to the Junction of the Poles, ſince they ought to ſtick together, according to the other Experiments which have been made, but only to this, that it hath been already noted, that when a magnetical *Virgula* is a little bent, it loſes its Virtue, which cannot happen, but from the Alteration of the Pores of the Steel.

I farther remarked, that a Ring of Steel having been touched, does for a long time retain its Virtue, although it be put in a Poſition contrary to its Poles. And this Experiment is confirmed by another much more conſiderable, which is, that a Ring of Steel having been touched with a ſtrong *Loadſtone*, cannot without difficulty receive a contrary Touch from a Magnet, leſs ſtrong than the firſt: But that in time, by little and little, it reſumes its former Virtue; much as we ſee Magnets do, which being applied to another Stone, by the Poles of the ſame Denomination, loſe their firſt Virtue and take a contrary, which they afterwards loſe by Degrees, to reaſſume their firſt.

After I had preſented this new Syſtem of the Magnet to the Academy, there were made ſome Experiments upon a *Terella* of much the ſame Diameter with mine, but whoſe Poles were not diametrically oppoſite; and upon a half Globe, very much bigger than the *Terella*: But we could find in them no conſiderable Difference, or Alteration of Poles. Becauſe of ſome Circumſtances, the Company thought fit that ſome Experiments ſhould be made with this Sort of Compaſs.

Theſe circular Needles may be touched anew after this manner; Apply the Poles of the Stone to the Ring, and the Ring which is ſuſpended upon its Pivot, will turn ſo as the Point anſwering to the Pole of the Virtue of the Stone which is applied to it, will come as near to it as poſſible: Inſomuch, that without touching the one or the other, the Ring will not fail to receive very much Force. The ſame may be done at the oppoſite Point.

The Principle examined, ib. p. 250.

2. This Account having been read before the *Royal Society*, it was ordered, that the *Terella* which has been in their Repoſitory theſe 25 Years, ſhould be examined; and it was found, that the Points which are marked thereon with Croſſes were, as near as could be diſcerned, the true Poles of the Stone, notwithſtanding that the Variation has changed at *London* full 4 *deg.* ſince the *Terella* has been in the Society's Cuſtody, and perhaps many more ſince it was marked; and had there been a Change in the Poles of the *Loadſtone* analogous thereto, it muſt needs have been perceived in this, whoſe Diameter is about 4¼ Inches. However, to put this Matter paſt Diſpute, Care was taken to find out exactly and mark the Poles of the *Society*'s great *Loadſtone*, the Sphere of whoſe Activity is above nine Foot Radius, and whoſe Poles are 13 Inches aſunder; whereby if this Tranſlation of the Poles be real, it cannot fail of being made very ſenſible hereafter. In the mean time, ſome of the Company well ſkilled in Magneticks, were of Opinion, that ſuch a circular Needle would librate on its Center, ſo as to reſpect the magnetical Meridian with the Points that had at firſt received the Touch, rather than that the Ring remaining immoveable, the directive Virtue ſhould be tranſferred therein from Place to Place, either by length of Time, or by tranſport-

ing this Compaſs into thoſe Parts, where the Variation of the Needle is conſiderably different.

IX. An Account of a Book, Omitted.

n. 143. p. 3. *Epiſtola invitatoria, ad Obſervationes Magneticæ Variationis, communi Studio junctiſque Laboribus inſtituendas,* Altorfi 1682.

CHAP. V.

Botany. Agriculture.

To preſerve the Specimens of Plants, by Sir Robert Southwell, *n.* 237. *p.* 42.

I. PREPARE two Plants of Iron as large as you deſire to preſerve the Specimens. Theſe Plates muſt be too thick to bend, very ſmooth on one Side, and Holes for Screws on each Corner, to ſcrew them cloſe. Then take your Flowers, Leaves, *&c.* when perfectly ripe, and in their true Colours, ſpread them on a Brown-Paper, with the Leaves as diſtinct as you can; and if the Flowers be large, there muſt more Paper lie under it, and if it be thick, you may pare away the one half thereof, as alſo of the Stalk, ſo as to make it lie almoſt flat; and ſome diſtinct Leaves may be ſeparated and taken out, as a By-ſtore, to be afterwards ſtuck in, and compleat the Flower. Then lay over all more Brown-Paper, and put theſe between Iron Plates, ſcrew them cloſe, put the ſame into an Oven for two Hours, juſt as the Bread is drawn; after which, take out the Flowers; then take *Aqua Fortis* and *Aqua Vitæ*, or *Brandy* in equal Quantity, mixed together, and with a Bruſh paſs over the Leaves of the Flowers. Then lay them on freſh Brown-Paper, and preſs them a little with a Handkerchief, or with your Fingers, to grow dry. Then take the Bigneſs of a Walnut of *Gum-Dragon*, which in leſs than twenty-four Hours will be diſſolved in a Pint of fair Water; and with a fine Bruſh, rub the Backſides of your Flowers and Leaves, to make them ſtick; and then lay them into your Paper-Book, where they will lie faſt, and always look freſh.

There muſt be a little Skill after the Oven, to turn the Leaves into Shape; and a ſort of Perſpective, in caſe the Flower be too thick: And if you would add any Smell to theſe Flowers, which will have none, touch them with ſuch Eſſence as you think fit.

*An odd kind of Muſhroon, by Dr.*Liſter, *n.*89. *p.*5116.

II. 1. As I paſſed through *Marton* Woods, under *Pinno Moor* in *Craven*, *Aug.* 18, 1672, I found an infinite Number of Muſhrooms, ſome withered, and others new ſprung and flouriſhing. They were of a large Size, ſomething bigger than the ordinary red Gilled eatable Muſhroon, or Champignon, and very much of their Shape, that is, with a perfectly round Cap, or Stool, as we vulgarly call it, thick in Fleſh, and with open Gills underneath, having a thick, fleſhy not hollow, and round Foot Stalk, of about ſix Fingers Breadth high above the Ground, and ordinarily as thick as my Thumb. If you cut any part of the Muſhroon, it will bleed exceeding freely a Milk-white Juice, which taſtes much hotter upon the Tongue than Pepper; it is not clammy to the Touch, and the Air does not much diſcolour it, or the Blade of a Knife, as is uſual with moſt vegetable Juices. It became in the Glaſs Vial I drew it into ſuddenly concrete and ſtiff, and did in ſome Days dry into a firm Cake; which alſo when well dried, retained its fierce biting Taſte and white Colour.

Further, I obſerved theſe Muſhrooms full of Juice, not to be endured upon our Tongues, to abound with Fly Maggots. Alſo the youngeſt and tendereſt of them, that is, ſuch as are moſt juicy, to have been very much eaten by the grey Meadow-naked Snail, lodging themſelves within the Side of the Plant.

By Mr. Wray, *ib. p.* 5117.

2. I doubt not but this Muſhroon is that deſcribed in *Joh. Baubin*, *l.* 40. *c.* 6. under the Title of *Fungus piperatus albus*, *lacteo ſucco turgens*. For in almoſt all Points the Deſcriptions agree exactly.

Another ſort of Muſhroons, by Dr. Liſter, *n.* 110. *p.* 225.

3. The *Fungus poroſus craſſus magnus J. B.* when freſh gathered, is of a Buff-Colour, inſide and outſide; and yet cut thro' the Middle, it will in a Moment change from a pale Yellow to a deep Purple or Blue, and ſtain Linen accordingly. A Drop of the Juice leiſurely ſqueezed out, will change, holding it betwixt your Eye and the Light, thro' all the Colours of the Rainbow, in the very time of its falling, and fix in a Purple, as it doth in the ſpringing out of its Veins.

The Flowers and Seed of Muſhroons, by Dr. Liſter, *n.* 110. *p.* 225.

III. I am of Opinion, that Muſhroons are Plants of their own kind, and have more than a chance Original. We will inſtance in that ſpecies called *Fungus poroſus craſſus magnus* J. B. The Texture of the Gills is like a Paper pricked full of Pin-holes. In *Auguſt* this is very frequent under Hedges, and in the middle of the Moors in many Places of *Yorkſhire*. It ſeems to me, (and no doubt, but it will to any Perſon that ſhall well examine it) that the Gills of this Muſhroon are the very Flower and Seed of this Plant. When it is ripe, the Gills here are eaſily ſeparable from the reſt of the Head: Each Seed is diſtinct from other, and hath its Impreſſion in the Head of the Muſhroon, juſt as the Seeds of an Artichoke hath in the Bottom of it. The bigger End of the Seed is full and round, and they are diſpoſed in a ſpiral Order, juſt as thoſe of an Artichoke. The like we do think of all other Muſhroons, however differently figured.

And if it ſhall happen to him that ſhall ſow them, that theſe will not produce their Kind, but be ſterile, it is no ſtrange thing amongſt Plants, there being whole Genus's of Plants that come up, and flower and ſeed, yet their Seed was never known to produce Plants of their Kind; being naturally ſterile, and in a volatile Duſt, as all *Orchides* or Bee-Flowers.

Truffles, by Dr. Tanc. Robinſon, *n.* 202. *p.* 814, 824. *n.* 214. *p.* 935.

IV. The *Tubera Terræ* obſerved lately at *Ruſhton* in *Northamptonſhire*, by Dr. *Hatton* of *Harborough* in *Leiceſterſhire*, are the true *French Truffles*, the *Italian Tartuffi*

Tartuffi or *Tartuffole*, and the *Spaniſh Turmas de Tiera*, which are not noted by Mr. *Ray*, to be found in our *Britiſh* Soil. I have ſeen them thrice as large at *Florence*, *Rome*, and *Naples*, where they eat them as a delicious and luxurious Piece of Dainty, either fried in Slices with Butter or Oil, Salt and Pepper, or elſe out of Pickle, and often boiled in their Soup. Theſe obſerved *Fig.*157. *Fig.*158. in *England* are all included in a ſtudded Bark or Coat, the *Tubercules* reſembling the *Capſules*, or Seed Veſſels, of ſome *Mallows* and *Alcea's*. The inward Subſtance of the Conſiſtence of the fleſhy Part in a young Cheſtnut, of a Paſte Colour, of a rank or hircine Odour, and unſavoury, ſtreaked with many white Veins or Threads, as in ſome Animals Teſticles. The whole is of a globoſe Figure, though unequal and chinky; they are moſt tender in the Spring, though after Showers and ſultry Weather, they may be plentifully found in the Autumn. The Wet ſwells them, and Lightning and Thunder may diſpoſe them to ſend forth their particular Scent ſo alluring to the Swine, for ſome of the Ancients called them *Ceraunia*.

*Fig.*157. Dr. *Hatton* obſerved Fibres iſſuing out of ſome of theſe *Tubera*, which lay Spit-deep under-ground, ſo that perhaps they may be *Plantæ ſui generis*, and their ſulcated *Papillæ* analogous to, if not Seed-Veſſels; you know ſeveral Vegetables bear their Seed near the Root, as the *Trifolium ſubterraneum tricoccum*, *reticulatum Floſculis longis albis*, moſt of the *Arachidna*'s, and ſome other *Legumes*, which flower above, but ſeed under Ground. As to the Truffles lying ſo deep, that is common to many Roots that ſhoot up Stalks above the Earth. To inſtance only in that *Lathyrus tuberoſus*, called commonly *Chamabalanus* and *Terræ Glandes*, in *Engliſh*, *Peaſe Earthnuts*, digged up and eaten by the poor People, *non niſi alta Foſſione inveniendæ*, ſays *John Baubine*. The Roots of our *Bulbocaſtanum* (of the umbelliferous Tribe) commonly called Kepper-nuts, Pignuts, and Gernuts, in the North, lie very deep, and fatten Hogs, which are very greedy of them.

A ſtrange ſort of Rye in France, *n.* 130. *p.* 758.

V. Some Years ſince M. *Perrault* related to the Royal Academy at *Paris*, that travelling thro' *Sologne*, he had been inform'd by ſome Phyſicians and Chirurgeons of that Country, that the *Rye* there was ſometimes ſo corrupted, that thoſe who did eat of the Bread which had much of this corrupted Grain in it, were ſeized on by a *Gangrene*. We have view'd ſome of theſe Grains of *Rye* thus degenerated, they are black without, and pretty white within, and when they are dry they are harder and cloſer than the natural good Grain. They have no ill Taſte. I have found ſome of them that had hanging at their Baſis a Subſtance of a Honey-Taſte and Conſiſtence. They become much longer in the Ear than the other. There are ſome of them that are 13 or 14 Lines long, and 2 Lines large, and at times you will find 7 or 8 of them in one Ear. It may be ſeen in examining theſe Ears, that they are not Bodies of another kind, generated among the Grain of *Rye*, as ſome pretend; but that they are true Grains of *Rye*, having their Coats like the reſt, wherein may be diſtinguiſhed the Place of the Germen, and of the Furrow.

There happened many like Accidents in 1674, at *Montargis*, from the ſame Cauſe. M. *Dodart* cauſed to be brought to him ſome Ears of this *Rye*, and the Company found the Grains of them altogether like thoſe they had ſeen formerly.

M. *Tuillier* hath imparted a Letter of M. *Chatton*, an old and expert Chirurgeon at *Montgarris*, whence he ſaith he hath learned the Particulars following, *viz.* *Rye* doth in this manner degenerate in *Sologne*, *Berry*, the Country of *Blaiſe* and *Gaſtinois*, and almoſt every where, eſpecially in light and ſandy Land. There are few Years but ſome little of this ill Grain grows. When there is but little, the ill effects of it are not perceived. It grows plenteouſly in wet Years, and moſt of all when after a rainy Spring there follows exceſſive Heats. The Conſtitution of the Air, or of the Rains, which impreſs this Malignity in the *Rye*, is rare, there having been found none at *Montgarris* but thrice in 38 Years, and there having been but few Diſtempers of it the ſecond time, becauſe there was but little of that corrupted Grain. The Bread made of the *Rye*, which holds ſome of this corrupted Corn, taſtes neither worſe nor better than other. The *Rye* thus corrupted hath its Effects chiefly when it is new, yet not till it hath been uſed a conſiderable time.

Theſe Effects are, to dry up the Milk in Women, to cauſe ſometimes malign Fevers, accompanied with Drowſineſs and Raving, to breed the Gangrene in Arms, but moſt in Legs, which ordinarily are corrupted firſt, and to which this Diſtemper faſtens itſelf, as the Scorbute doth. This Corruption is preceded by a certain Stupefaction in the Legs, upon which follows a little Pain, and ſome Swelling without Inflammation, and the Skin becomes cold and livid. The Gangrene begins at the Centre of the Part, and appears not at the Skin till a long while after, ſo that People are often obliged to open the Skin, to find only the Gangrene lurking under it.

The only Remedy for this Gangrene is to cut off the Part affected: If it be not cut off, it becomes dry and lean, as if the Skin were glued over the Bones; and it is of a dreadful Blackneſs, without Rottenneſs.

Whilſt the Legs are drying up, the Gangrene aſcends to the Shoulders, and one knows not which way it communicates itſelf.

We have not as yet lighted upon a Specifick Remedy againſt this Evil. There is ſome Hope of preventing it by hot Spirits and volatile Salts. The *Orvietan* and *Ptyſan* of *Lupins* do conſiderable good to the Perſon diſtempered. Poor People are almoſt only ſubject to theſe Evils.

M. *Tuillier* alſo writes Word, That in 1675 he ſaw much of this cornuted Grain among the *Rye* of the Country of *Gaſtinois*; and that the Country People told him, that there was much more of it this Year 1676, than the laſt Year, and that it cauſed great Diſorders: And yet it is certain that this Summer hath been rather cold than hot, and that there hath not been any conſiderably intemperate Weather this Year, but Exceſs of Wet.

However, it may be doubted, whether theſe Gangrenes are the Effects of this Corn eaten, or whether the Corruption of the *Rye*, and that of the parts in the Bodies of Men, are not Accidents equally derivable from the ſame Conſtitution of the Air, and independent the one from the other. Yet M. *Tuillier* has aſſured M. *Doddard*, That in the Year 1630, which was fatal to the Poor of the Countries ſubject to theſe Evils, he being at *Sully*, and having underſtood by a Phyſician and Chirurgeon, that the cornuted *Rye* was the Cauſe of the *Gangrenes* that were then very frequent, being deſirous to ſatisfy himſelf whether this Grain was indeed the Cauſe thereof, he gave of it to ſeveral Animals, which died of it.

To make Malt; By *Sir* Robert Murray, *n.* 142. *p.* 1069

VI. *Malt* is made in *Scotland* of no other Grain than Barley, whereof there are two Kinds; one of which hath four Rows of Grain on the Ear, the other two Rows. The firſt is the more commonly uſed, but the other makes the beſt *Malt*,

The more recently Barley hath been threſhed, it makes the better *Malt*, but if it hath been threſhed ſix Weeks, or upwards, it makes not good *Malt*, unleſs it be kept in one equal Temper; whereof it eaſily fails, eſpecially if it be kept up againſt a Wall; for that which lies in the middle of the Heap is freſheſt; that which lies on the outſides and at Top is over-dried; that which is next the Wall ſhoots forth, and that which is at the Bottom rots. So that ſome Grains do not come well (as they call it) that is, never get that right mellow Temper *Malt* ought to have, and ſo ſpoil all the reſt: For thus ſome Grains come well, ſome not at all, ſome half, and ſome too much.

The beſt Way to preſerve threſhed Barley long in good Temper, is, not to ſeparate the Chaff from it; but as long as it is unthreſhed, it is always good. Brewers uſe to keep their Barley in large Rooms on boarded Floors, laid about a Foot in depth, and ſo turned over now and then with Scoops.

Barley that hath been over-heated in the Stacks or Barns, before it be ſeparated from the Straw, will never prove good for *Malt*, nor any other Uſe. But though it heat a little after it is threſhed and kept in the Chaff, it will not be the worſe, but rather the better for it, for then it will come the ſooner, and more equally. A mixture of Barley that grows on ſeveral Grounds, never proves good *Malt*, becauſe it comes not equally: So that the beſt Barley to make *Malt* of, is that which grows in one Field, and is kept and threſhed together.

Take then good Barley newly threſhed, and well purged from the Chaff, and put hereof eight Bolls, that is about ſix *Engliſh* Quarters, in a Stone Trough; where let it infuſe till the Water be of a bright reddiſh Colour, which will be in about three Days, more or leſs, according to the Moiſtneſs or Dryneſs, Smallneſs or Bigneſs of the Grain, Seaſon of the Year, or Temper of the Weather. In Summer *Malt* never makes well; in Winter it will need longer Infuſion than in the Spring or Autumn.

It may be known when ſteeped enough, by other Marks beſides the Colour of the Water, as, the exceſſive ſwelling of the Grain, or if over-ſteeped, by too much Softneſs; being, when in the right Temper, like that Barley which is prepared to make Broth of.

When the Barley is ſufficiently ſteeped, take it out of the Trough, and lay it on Heaps, ſo let the Water drain from it: Then, after two or three Hours, turn it over with a Scoop, and lay it in a new Heap about 20 or 24 Inches deep.

This Heap they call the coming Heap, and in the managing of this Heap aright lies the greateſt Skill. In this Heap it will lie 40 Hours, more or leſs, according to the forementioned Qualities of the Grain, *&c.* before it come to the right Temper of *Malt*, which that it may do equally, is moſt to be deſired.

Whilſt it lies in this Heap, it is to be carefully looked to, after the firſt 15 or 16 Hours: For about that time the Grain will begin to put forth the Root, which when they have equally and fully done, the *Malt* muſt within an Hour after be turned over with a Scoop, otherwiſe the Grains will begin to put forth the Blade or Spire alſo, which by all means muſt be prevented; for hereby the *Malt* will be utterly ſpoiled, both as to the pleaſantneſs of Taſte and Strength.

If all the *Malt* comes not equally, becauſe that which lies in the Middle being warmeſt, will uſually come firſt, turn it over, ſo as the outmoſt may lie inmoſt, and ſo leave it till all become alike.

So ſoon as the *Malt* is ſufficiently come, turn it over, and ſpread it to a depth not exceeding 5 or 6 Inches; and by that time it is all ſpread out, begin and turn it over and over again, three or four times. Afterwards, turn it over in like manner once in 4 or 5 Hours, making the Heap thicker by Degrees, and continuing ſo to do conſtantly, for the Space of 48 Hours at leaſt. This frequent turning it over, cools, dries, and deads the Grain, whereby it becomes mellow, melts eaſily in Brewing, and then ſeparates entirely from the Huſk.

Then throw up the *Malt* into a Heap, as high as you can; where let it lie till it grows as hot as your Hand can endure it, which uſually comes to paſs in ſome 30 Hours Space. This perfects the Sweetneſs and Mellowneſs of the *Malt*.

After the *Malt* is ſufficiently heated, throw it abroad to cool, and turn it over again about 6 or 8 Hours after, and then dry it upon a Kiln; where after one Fire, which muſt ſerve for 24 Hours, give it another more ſlow, and if need be a third. For if the *Malt* be not thoroughly dried, it cannot be well ground, neither will it diſſolve well in the Brewing, and the Ale it makes, will be red, bitter, and will not keep.

The beſt Fuel is Peat, the next Charcoal, made of Pit-coal or Cinders, Heath-Broom and Furzes are naught. If there be not enough of one Kind, burn the beſt firſt, for that gives the ſtrongeſt Impreſſion as to the Taſte.

The Granaries *in* London *by Dr.* Merrit, *n.* 25. *p.* 464.

VII. 1. All the Twelve Companies of *London*, and ſome other Companies, and private Perſons, have their *Granaries* at the *Bridge-Houſe* in *Southwark*: (where are a Juſtice of the Peace, a Steward, and two Maſters.) Theſe *Granaries* are built on two Sides of an oblong Square; one whereof ſtands North and South, and is near 100 Yards long; whoſe Lettice-Windows reſpect North-Eaſt; the other Side may be about 50 Yards long; the Windows look to the North, and the oppoſite Sides have no Apertures. All the Windows are about a Yard high, without any Shutters, and run on in a continued Series,

ries, with very ſmall Partitions, ſufficient only to nail the Lettices to; each of them is 3 or 4 Stories high. The Ground or lowermoſt Story, 12 Foot from the Ground, is uſed only for a Ware-houſe, *&c.* to ſettle the firſt Story upon ſtrong Pillars, fortified with Spikes of Iron, that no Vermin might get up, would make that Story fitter for drying of Corn, and more perflatile. In ſome Places they put, in all the Inſide of their Rooms, Iron Wire of ſo narrow Meſhes, that neither Rats nor Mice can get thro' them, 2 or 3 Foot deep. Others erect, on all ſides, Boards of Timber, and faſten others to the top of the perpendicular one, lying either parallel to the Horizon, or ſo that they make an acute Angle with the former, to the ſame Purpoſe: For, beſides the devouring of the Grain, the Excrements and Urine of the Vermin moiſtening the Wheat or Rye, make them apt to corrupt and breed Weevels.

The two main Conſiderables in building theſe Granaries, are, to make them ſtrong, and to expoſe them to the moſt drying Winds.

The ordering of their Corn is this, in *Kent*, to ſeparate the Duſt and other Impurities in it, when 'tis threſh'd, they throw it in Shovels, from one Side to the other, which the longer it is, the better; by which means all ſuch Impurities remain in the middle, betwixt the two Heaps of Corn, which they ſkreen to part the Corn that is good, from the ſaid Impurities. Then when they bring the Grain into the Granaries, they lay it about half a Foot thick, and turn it twice a Week, and once in that time ſkreen it; and this for 2 Months ſpace. After that they lay it a Foot thick for 2 Months or more, turning it once or twice a Week, and ſkreen it proportionably, according as the drying Seaſon is, ſeldomer or oftner. After 5 or 6 Months they raiſe it to 2 Foot in height, and turn it once a Fortnight, and ſkreen it once a Month, as occaſion is. After a Year, they lay it two and a half, or 3 Foot deep, and turn it once in three Weeks, or a Month, and ſkreen it proportionably.

When it hath lain 2 Years or more, they turn it once in 2 Months, and ſkreen it once a Quarter, and ſo on, as they find it in Brightneſs, Hardneſs, and Dryneſs. The oftner theſe two things are done, the better the Grain proves. They leave an empty Space about a Yard wide on all ſides of the Room, and at 6 Foot diſtance, thro' the whole *Area*, empty of Corn; into which empty Places they turn the Corn as often as 'tis needful.

In *Kent* they make 2 ſquare Holes in both the ends of the Floor, and one round in the middle; by which they throw the Corn from the upper into the lower Rooms, *&* *contra*, to air and dry it the better.

The Skreens are made with 2 Partitions, to ſeparate the Duſt from the Corn, which falls into a Bag; and when ſufficiently full, is caſt away, the good Corn remaining behind.

Corn has been kept in *London* Granaries 32 Years, and the longer 'tis kept the more Flower it yields, in proportion to the quantity of Corn, and makes the purer and whiter Bread; the ſuperfluous Humidity only evaporating.

At Zurich; *By Dr.*Pell, *ib.*

2. Dr. *Pell* mention'd at a Meeting of the *Royal Society*, that they keep Corn at *Zurich* in *Helvetia* 80 Years.

In Dantzick *and* Muſcovy; *By* . . . *ib. p.* 466.

3. Obſerving Merchants and Travellers tell us, that the Granaries of *Dantzick* are generally 7 Stories high, and ſome 9 Stories; having each of them a Funnel, to let the Corn run down from one Floor to another, thereby chiefly ſaving the Labour and Charges of carrying it down. And then, that they in that Town are built altogether ſurrounded with Water, whereby the Ships have the Conveniency of lying cloſe to them, to take in their Lading. No Houſes are ſuffered to be built near them, to be thereby ſecured from the Caſualties of Fire.

Thoſe of *Muſcovy* are made under-ground, by digging a deep pit, of almoſt the Figure of a Sugar-Loaf, broad below, and narrow at the Top; the Sides well plaiſtered round about, and the Top very cloſely covered with Stone.

The People of that Country are ſo very careful, to have the Corn well dried, before they put it into thoſe ſubterraneous Granaries, that when the Weather of that *Northern Climate* ſerves not to dry it ſufficiently, they heat their Barns by the means of great Ovens; and thereby well drying their Corn, ſupply the Deficiency of their ſhort Summer.

Turnep and Potato Bread; *By Dr.* Beal, *n.* 90. *p.* 5142.

VIII. 1. In the Year 1629, and 1630, there was a Dearth in *England*; and much Talk they had then, that in *London* they had a way to knead and ferment boiled *Turneps* with a ſmall Quantity of Meal, and that it made better *Bread* for Whiteneſs, Pleaſantneſs, Laſting and Wholſomeneſs, than is made of the fineſt Flour or Wheat. *Turneps*, *Rapes*, *Carrots*, *Parſnips*, *Potatoes*, and other Roots, lie ſafe under Ground from ſcorching Heat, and are ſaid to thrive beſt in the greateſt Rain. *Potatoes* were a Relief to *Ireland* in their laſt Famine. They yield Meat and Drink.

Turnep-Bread; *By Mr.* Sam. Dale, *n.*205. *p.* 970.

2. The Dearneſs of all Sorts of Corn in 1693, occaſioned many poor People in *Eſſex* to make Bread of *Turneps*. The way of making it is this, they take pilled *Turneps*, and boil them in Water until they are ſoft or tender; then preſſing ſtrongly out the Juice, they mix them with their Weight of Wheat-Meal, then adding Salt and Yeaſt, of each *q. ſ.* and warm Water, they knead it up as other Dough and Paſte; which having lain a little while to ferment, they order and bake it as common Bread. This *Turnep-Bread*, to the Eye, is not to be diſtinguiſhed from common Wheaten or Houſhold Bread; neither doth the Scent much betray it, eſpecially when cold; only to dainty and nice Palates, the *Turneps* are a little, and but a little perceived.

The Culture of Maize; *By Mr.* Winthorp, *n.* 142. *p.* 1065.

IX. The Corn uſed in *New-England* before the *Engliſh* planted there, is called by the Natives *Weachin*, and is known by the Name of *Maize* in ſome Southern Parts of *America*. The Ear is for the moſt part about a Span long, compoſed of ſeveral, commonly 8 Rows of Grain, or more, according to the Goodneſs of the Ground; and in each Row, uſually above 30 Grains. It is of various Colours, as red, white, yellow, blue, olive, greeniſh, black, ſpeckled, ſtriped, *&c.* ſometimes in the ſame Field and the ſame Ear. But the white and yellow are the moſt common.

The Ear is clothed and armed with ſeveral ſtrong thick Huſks, not only defending it from the cold of the Night, (being the latter end of *September*, in ſome Parts, before it be full ripe) and from unſeaſonable Rains; but alſo from the Crows, Starlings, and other Birds; which being allured by the ſweetneſs of the Corn before it hardeneth, come then in great Flights into the Fields, and pecking thro' the top of the Cover, devour as far as they can reach.

The Stalk groweth to the height of 6 or 8 Feet, more or leſs, according to the condition of the Ground, or kind of Seed. The *Virginian* groweth taller than that of *New-England:* And there is another ſort uſed by the Northern *Indians* far up in the Country, that groweth much ſhorter than that of *New-England.* 'Tis always jointed like a Cane, and is full of ſweet Juice, like the Sugar-Cane; and a Syrup as ſweet as Sugar may be made of it, as hath been often tried. And Meat ſweetned with it, hath not been diſtinguiſhed from the like ſweetned with Sugar. At every Joint there are long Leaves almoſt like Flags, and at the top a Bunch of Flowers, like the Bloſſoms of Rye.

It is planted between the middle of *March* and the beginning of *June*; but moſt commonly from the middle of *April* to the middle of *May*.

In the more Northerly Parts they have a peculiar kind called *Mohauks-Corn*, which tho' planted in *June*, will be ripe in Seaſon. The Stalks of this kind are ſhorter, and the Ears grow near to the bottom of the Stalks, and are generally of divers Colours.

The manner of planting is in Rows, at equal diſtance every way, about 5 or 6 Feet.

They open the Earth with an Hoe, taking away the Surface 3 or 4 Inches deep, and the breadth of the Hoe; and ſo throw in 4 or 5 Grains, a little diſtant one from another, and cover them with Earth. If two or three grow, it may do well, for ſome of them are uſually deſtroyed by Birds, or Mouſe-Squirrels.

The Corn grown up an Hand's length, they cut up the Weeds, and looſen the Earth about it, with a broad Hoe, repeating this Labour as the Weeds grow. When the Stalk begins to grow high, they draw a little Earth about it, and upon the putting forth of the Ear, ſo much as to make a little Hill, like a Hop Hill; after this they have no other Buſineſs about it till Harveſt.

After 'tis gathered, it muſt, except laid very thin, be preſently ſtripped from the Huſks, otherwiſe it will heat, grow mouldy, and ſometimes ſprout: The common way (which they call Tracing) is to weave the Ears together in long Traces by ſome parts of the Huſks left thereon. Theſe Traces they hang upon Stages, or other Bearers within Doors, or without: For, hung in that manner, they will keep good and ſweet all the Winter after, tho' expoſed to all Weathers.

The Natives commonly threſh it as they gather it, dry it well on Mats in the Sun, and then beſtow it in Holes in the Ground (which are their Barns) well lined with withered Graſs and Mats, and then covered with the like, and over all with Earth; and ſo it is kept very well, till they uſe it.

The *Engliſh* have now taken to a better Way of Planting by the Help of the Plough, in this manner: In the Planting-time they plough ſingle Furrows through the whole Field, about 6 Foot diſtant, more or leſs, as they ſee convenient: To theſe they plough others acroſs at the ſame Diſtance. Where theſe meet they throw in the Corn, and cover it either with the Hoe, or by running another Furrow with the Plough. When the Weeds begin to over-top the Corn, then they plough over the reſt of the Field between the planted Furrows, and ſo turn in the Weeds. This is repeated where they begin to hill the Corn with the Hoe; and ſo the Ground is better looſened than with the Hoe, and the Roots of the Corn have more liberty to ſpread.

Where any Weeds eſcape the Plough, they uſe the Hoe.

Where the Ground is bad and worn out, the *Indians* uſed to put two or three of the Fiſhes called *Aloofes*, under or adjacent to each Corn-hill, where they had many times a Crop double to what the Ground would have otherwiſe produced. The *Engliſh* alſo have learned the like Huſbandry, where theſe *Aloofes* come up in great Plenty, or where they are near the Fiſhing-ſtages: having there the Heads and Garbage of Cod-fiſh in Abundance, at no Charge but the fetching.

The Fields thus ploughed for this Corn, after the Crop is off, are almoſt as well fitted for *Engliſh* Corn, eſpecially Summer Grain, as Peaſon or Summer Wheat; as if lying fallow, they had a very good Summer Tilth.

The *Indians*, and ſome *Engliſh* (eſpecially in good Ground, and well fiſhed) at every Corn-Hill, plant with the Corn a kind of *French* or *Turkey* Beans: The Stalks of the Corn ſerving inſtead of Poles for the Beans to climb up with. And in the vacant Places between the Hills, they will plant Squaſhes and Pompions, loading the Ground with as much as it will bear. And many, after the laſt Weeding, ſprinkle Turnep-ſeed between the Hills, and ſo, after the Harveſt have a good Crop of Turneps. The Stalks of this Corn, cut up before too much dried, and ſo laid up, are good Winter-Fodder for Cattle. But they uſually leave them on the Ground for the Cattle to feed on. The Huſks about the Ear are good Fodder, given for Change ſometimes after Hay. The *Indian* Women ſlit them into narrow Parts, and ſo weave them artificially into Baſkets of ſeveral Faſhions.

This Corn the *Indians* dreſſed ſeveral Ways for their Food; ſometimes boiling it whole till it ſwelled and became tender, ſo either eating it alone, or with their Fiſh and Veniſon inſtead of Bread; ſometimes bruiſing it in Mortars, and ſo boiling it; but commonly this Way, *viz.* by parching it in Aſhes or Embers, ſo artificially ſtirring it, as without burning to be very tender, and turned almoſt inſide outward, and alſo white and floury. This they ſift very well from the Aſhes, and beat it in their wooden Mortars with a long Stone for a Peſtle, into fine Meal. This is a conſtant

Food at home, and eſpecially when they travel, being put up in a Bag, and ſo at all times ready for eating either dry or mixed with Water. They find it very wholſome Diet: And the *Engliſh* ſometimes for Novelty will procure ſome of this to be made by the *Indian* Women, adding Milk or Sugar and Water to it, as they pleaſe.

The *Indians* have another ſort of Proviſion out of this Corn, which they call ſweet Corn. When the Corn in the Ear is full, while it is yet green, it hath a very ſweet Taſte. This they gather, boil, and then dry, and ſo put it up into Bags or Baſkets for their uſe; boiling it again, either whole, or groſly beaten, when they eat it, either by itſelf, or amongſt their Fiſh, or Veniſon, or Beavers, or other Fleſh, accounting it a principal Diſh.

Theſe green and ſweet Ears they ſometimes roaſt before the Fire, or in the Embers, and ſo eat the Corn; by which means they have ſufficient ſupply of Food, tho' their old ſtore be gone.

The *Engliſh*, of the full ripe Corn ground, make very good Bread: But 'tis not ordered as other Corn. For if it be mixed into ſtiff Paſte, it will not be ſo good, as if made only a little ſtiffer than for Puddings, and ſo baked in a very hot Oven, ſtanding therein all Day, or all Night. Becauſe upon the firſt pouring of it on the Oven Floor, it ſpreads abroad, they pour a ſecond Layer or Heap upon every firſt, and thereby make ſo many Loaves, which if baked enough, and good, will be of a deep yellowiſh Colour; if otherwiſe, white.

It is alſo ſometimes mixed with half, or a third part of Rye or Wheatmeal, and ſo with Leaven or Yeaſt, made into Loaves of very good Bread.

Before they had Mills, having firſt watered and huſked the Corn, and then beaten it in wooden Mortars, the coarſer part ſifted from the Meal, and ſeparated from the looſe Hulls by the Wind, they boiled to a thick Batter: to which, being cold, they added ſo much of the fine Meal as would ſerve to ſtiffen it into Paſte, whereof they made very good Bread.

The beſt ſort of Food which the *Engliſh* make of this Corn, is that they call Samp. Having firſt watered it about half an Hour, and then beaten it in a Mortar, or elſe ground it in a hand or other Mill, into the bigneſs of Rice, they next ſift the Flour, and winnow the Hulls from it; then they boil it gently till it be tender, and ſo with Milk, or Butter and Sugar, make it into a very pleaſant and wholeſome Diſh.

This was the moſt uſual Diet of the firſt Planters in theſe Parts, and is ſtill in uſe amongſt them, as well in Fevers as in Health; and was often preſcribed by the learned Dr. *Wilſon* to his Patients in *London*. And of the *Indians* that live much upon this Corn, the *Engliſh* moſt acquainted with them, have been informed by them, that the Diſeaſe of the Stone is very ſeldom known amongſt them.

The *Engliſh* have alſo found out a way to make very good Beer of this Grain, that is, either of Bread made thereof, or elſe by Malting it. The way of making Beer of Bread, is by breaking or cutting it into great Lumps, about as big as a Man's Fiſt, to be maſhed, and ſo proceeded with as Malt, and the impregnated Liquor, as Wort, either adding or omitting Hops, as is deſired.

To make good Malt of this Corn, a particular way muſt be taken. The Barley Malt-maſters have uſed all their Skill to make good Malt thereof the ordinary way, but cannot effect it; that is, that the whole Grain be melted, and tender and floury, as in other Malt. For it is found by Experience, that this Corn before it be fully malted, muſt ſprout out both ways, *i. e.* both Root and Blade to a great Length, of a Finger at leaſt, if more, the better. For which, it muſt be laid upon an Heap a convenient time; wherein on the one hand, if it lieth of a ſufficient thickneſs for coming, it will quickly heat and mould, and the tender Sprouts be ſo entangled, that the leaſt opening of the Heap breaks them off, and ſo hinders the further Maturation of the Grain into *Malt*: On the other, if it be ſtirred and opened to prevent too much heating, the Sprouts which have begun to ſhoot, ceaſe growing, and conſequently the Corn again ceaſes to be promoted to the Mellowneſs of *Malt*.

To avoid all theſe Difficulties, this way was tried and found effectual. Take away the Top of the Earth in a Garden or Field 2 or 3 Inches, throwing it up half one way and half the other; then lay the Corn for *Malt*, all over the Ground ſo as to cover it; then cover the Corn with the Earth that was pared off, and there is no more to do, till you ſee all the Plat of Ground like a green Field, covered over with the Sprouts of Corn, which will be within 10 Days or a Fortnight, according to the time of the Year: Then take it up and ſhake the Earth from it, and dry it; for the Roots will be ſo intangled together, that it may be raiſed up in great Pieces. To make it very clean, it may be waſhed, and then preſently dried on a Kiln, or in the Sun, or ſpread thin on a Chamber-Floor.

This way every Grain that is good will grow, be mellow, floury and very ſweet; and the Beer made of it, will be wholeſome, pleaſant and of a good brown Colour: Yet Beer made of the Bread as aforeſaid, is as well coloured, as wholeſome and pleaſant, and more durable, this therefore is moſt in uſe.

Improvement to be made by Maize, *by Sir* Richard Bulkley, *n.* 205. *p.* 928.

X. 1. The greateſt Profit that ever I have heard of the Field White Peaſe, has been 20 Barrels reaped for one ſown; but *Maize* will yield more than 2000 for one. I made an Experiment in *Ireland*, with a Grappe of 8 Sides, or Rows, having in each 30 Grains, (which grew in *Brandenburgh*) in good Orchard Ground, which had been indeed dunged for ſome other Legumes the laſt Year, and ſowed them in Rows; each Row being about a Yard aſunder, and each Grain about a Foot aſunder in the Row, taking care to preſerve them from the Mice till above Ground. Now out of each Grain come up 3, 4, 5 or 6 Stems, (my *Swiſs* ſays, he rarely has ſeen above 2 or 3 elſewhere) every of which Stems had 4, 3 or 2 of theſe Grappes. So that we may ſuppoſe, that each Grain will give 3 ſtrong Stems, and each of theſe Stems 3 Grappes, and each Grappe 240 Grains, which makes 2160 for one.

There are ſome things very odd in the manner of its Growth; it firſt ſends up a thick reedy Stalk, about a Yard high, with long Leaves of a very thick woody Subſtance, and half a Yard long, enwrapping the Stalk, juſt like the *Iris.* At the top of this Stalk, when the Leaves open, there appear 20 or 30 Ears, as it were of our unripe Wheat, but this when it is opened muſt be plucked away, for it is nothing but the Flower; and what is moſt ſurprizing, the Fruit comes not where the Flower was, but on the inner ſide of every Leaf where it joins to the Stem, comes forth, after a time, a large Shoot, thicker than ones Wriſt, at the end of which hangs out a Bundle of fine Strings, like a Horſe-Tail, which is the true Flower of the Plant. As this withers, the Fruit grows on within, being enveloped in a great Number of Leaves, which when they are withered, the Fruit is ripe, (but is never naked while on the Stalks) and muſt then be taken off, and hung up to dry, or kept in Cheſts. It will ſerve for all the Uſes of the White Pea (to which Grain it is the moſt like in Taſte and Figure) either in Bread, (with Wheat) or Soup, or Pudding, or with Pork.

Conſider'd by Mr. J. Ray, ib. p. 930.

2. If the *Maize* be equal in goodneſs to Peas, and an Acre planted with it, it will certainly yield more than one ſown with Peaſe, without impoveriſhing the Land, then indeed it will be advantageous to plant it; but if only an equal Quantity, then tho' one Grain ſhould yield 1000 fold, all the Advantage will be in the difference of the Seed, which is not very conſiderable; and which the Compendium of ſowing above ſetting may in ſome meaſure countervail.

By Sir *Richard*'s Deſcription of it, I am confirmed in my Opinion, That there are two really diſtinct Species of *Maize*; for what I have ſeen cultivated in Gardens, and have myſelf planted, ariſeth to double the Stature he aſcribes to this, that is, 7, 8, or 10 Feet; and beſides, with us, never brings the Seed near to Perfection. But that I have ſeen planted in the Fields in *Germany*, is of about the ſame height with Sir *Richard*'s, and ripens the Seed. *Lobel* alſo acknowledges two ſorts thus differing.

An extraordinary Spirit of Sugar, by Dr. Lucas Hodgeſon, n. 130. *p.* 766.

XI. A Diſtiller with us (at *Newcaſtle*) hath made a quantity of an extraordinary Spirit of Sugar. It ſeems to be the Reſult of ſome anomalous Fermentation: It is ſo ſtrong that no Man is able to ſmell it in an open Veſſel, without being made almoſt breathleſs; neither do I think the Perſon who made it, can make it again. It was drawn from bare Sugar-water (which is nothing but the Water wherewith the Molds, Aprons, &c. are waſhed) fermented with the Scum; and it was ſo exceeding Volatile, that it would not be carried, but loſt all its Force in the Carriage, tho' it was very well ſtopped.

The Culture of Saffron, by Mr. Ch. Howard, n. 138. *p.* 945.

XII. *Saffron-heads* planted in a black rich ſandy Mold, or in a mixt ſandy Land, between white and red, yields the greater ſtore of *Saffron*. A Clay, or ſtiff Ground, be it ever ſo rich, produceth little *Saffron*, though Increaſe of *Heads* or *Roots*, if the Winter prove mild and dry; but the Extremity of Cold and Moiſture will rot them. So that the fineſt light ſandy Mold, of an indifferent Fatneſs, is eſteemed moſt profitable.

Plough the Ground in the beginning of *April*, and lay it very ſmooth and level.

About 3 Weeks or a Month after, ſpread upon every Acre 20 Loads of rotten Dung, and plough it in.

At *Midſummer* plough it again, and plant the *Saffron Heads* in Rows, every way 3 Inches diſtant one from another, and 3 Inches deep.

The moſt expedite way of Planting, is to make a Trench the whole length of the Field, 3 Inches deep, with a Spit-ſhovel. The Spit-ſhovel is to be made of a thin ſtreight Iron 10 Inches long, and 5 Inches broad, with a Socket in the ſide of it to put to a Staff or Handle. Lay the *Saffron-heads* 3 Inches diſtant in the Trench, and with the Shovel ſpit up 3 Inches of Earth upon them.

Obſerve this Order in planting of whole Fields, whereby the Heads will lie every way 3 Inches one from another. Only Paths or ſhallow Trenches are to be left 2 or 3 Yards aſunder, which ſerve every Year to lay the Weeds to rot, that are to be weeded and pared off the Ground.

As ſoon as the Heads begin to ſhoot or ſpear within the Ground, which is uſually a Fortnight before *Michaelmas*, hoe or pare the Ground all over very thin, and rake lightly all the Weeds and Graſs very clean, leſt it choak the Flowers, which will ſoon after appear; and are then to be gathered, and the *Saffron* to be picked and dried for Uſe.

The Ground muſt be very carefully fenced from Sheep or Cattle, which by treading break the *Saffron-graſs*, and make the Chives come up ſmall.

In *May*, the *Saffron-graſs* will be quite withered away; after which the Weeds and Graſs the Ground produceth, may be cut or mowed off from time to time to feed Cattle till about *Michaelmas*, at which time the Heads will begin to ſpear within the Ground. Then hoe, pare and rake the Ground clean as before, for a ſecond Crop. The like Directions are to be obſerved the next Year for a third Crop. The *Midſummer* following, dig up all the *Saffron-heads*, and plant them again in another new Ground, dunged and ordered as aforeſaid, wherein no *Saffron* hath been planted, at leaſt not within 7 Years.

The Flowers are to be gathered as ſoon as they come up, before they are full blown, whether wet or dry.

Pick out the Chives clean from the Shells or Flowers, and ſprinkle them 2 or 3 Fingers thick, very equally on a double Saffron paper. Lay this on the Hair-cloth of the Saffron-Kiln, and cover it with 2 or more Saffron-papers, a piece of woollen Cloth, or thick Bays, and a Cuſhion of Canvas, or Sackcloth, filled with Barley-ſtraw, whereon lay the Kiln Board.

Put into the Kiln, thoroughly kindled, Charcoal, Oven-Coaks, or the like, keeping it ſo hot, that you can hardly endure your Fingers between the Paper and the Hair-cloth.

After an Hour or more turn in the Edges of the Cake with a Knife, and looſen it from the Paper. If it ſtick faſt, wet the out ſide of the Paper with a Feather dipped in Beer, and then dry the Papers. Turn the Cake, that both ſides may be of a Colour.

If it ſtick again to the Paper, looſen it, and then dry it with a very gentle Heat, with the Addition of a Quarter of a hundred Pound Weight laid upon the Kiln-board.

The *Saffron* Cake being ſufficiently dried, is fit for Uſe, and will laſt a good many Years, being wrapped up and kept cloſe.

The beſt *Saffron* is that which conſiſts of the thickeſt and ſhorteſt Chives, of a high red and ſhining Colour, both without and within alike.

Saffron is oftentimes burnt, and in Knots, ſpotted, and mixed with the Yellows that are within the Shells.

It is uſually obſerved, that an Acre doth yield, at the leaſt, 12 Pounds of good *Saffron* one Year with another; and ſome Years 20 Pounds.

Good *Saffron* is ſeldom or never ſold at ſo low a Rate as 30 Shillings *per* Pound, frequently at 3 Pounds *per* Pound, and upwards. Wherefore one Acre bearing 12 Pounds at 40 Shillings *per* Pound, cometh to 24 Pounds *per Annum*.

The gathering and picking of one Pound of *Saffron* is worth one Shilling, which cometh to 12 Shillings *per* Acre.

The Fire and Care of drying may come to 3 Shillings more, at 6 Pence the Pound; which is in all 15 Shillings.

The Graſs that is mowed and cut off the Ground for the Uſe of Cattle, will be very near worth as much as will countervail the picking and drying the *Saffron*; the Soil being enriched, not only by the Dung, but the *Saffron* itſelf, as appears by the rich Crops the Ground yields for ſeveral Years after, without any other Manuring or Improvement.

Sixteen Quarters of *Saffron*-Heads are ſufficient to plant one Acre. A Quarter of theſe Heads is uſually ſold in the Place for 10 Shillings, which comes to 8 Pounds *per* Acre.

Twenty Loads of rotten Dung laid on the Ground, may be worth 40 Shillings at 12 Pence a Load for the Dung, and as much for Carriage into the Field.

For thrice Ploughing the Ground 20 Shillings.

For planting the Heads about 4 Pounds. Which in the whole makes 14 Pounds the Charges of planting an Acre, which will bear 3 Crops.

So that all things reaſonably computed, it appears that an Acre of *Saffron* will be worth, notwithſtanding all Caſualties, one Year with another, over and above the 14 Pounds Charges, for the firſt Year's Planting (at the leaſt) 20 Pounds *per Annum*; beſides the great Increaſe of the *Saffron*-Heads, which will be as three for one.

The Kiln conſiſts of an Oaken Frame, lathed on every Side; 12 Inches ſquare in the Bottom, 2 Foot high, and 2 Foot ſquare at the Top; upon which is nailed a Hair-cloth, and ſtrained hard by Wedges drove into the Sides; a ſquare Board, and a Weight to preſs it down, weighing about a quarter of an Hundred.

The Inſides of the Kiln are covered all over with the ſtrongeſt Potters Clay, very well wrought with a little Sand, a little above 2 Inches thick.

The Bottom muſt be lined with Clay 4 or 5 Inches thick, which is the

Hearth to lay the Fire on: Level wherewith is to be made a little Hole to put the Fire. The outſide may be plaſtered all over with Lime and Hair.

Melons ordered by M. De la Quintiney, *n.* 45. *p.* 901.

XIII. The firſt thing appearing of Melons are two Leaves united, here called Ears (marked 1. 1.) out of the midſt of theſe two Ears there ſhoots ſome Days after, firſt one Leaf, which call the firſt Leaf or Knot (marked 2.) and out of the ſame place, after ſome Days more, ſhoots a ſecond, called the ſecond Knot (marked 3.) out of about the midſt of the Stalk of this ſecond Knot ſhoots the 3d Knot (marked 4.) And this 3d Knot it is, which muſt be cut at the place marked 6, without hurting the Branch of the 2d Knot, whence this third came; becauſe that from that Place will ſpring a Branch, which we call the firſt Arm, and this Arm will ſhoot forth firſt one Knot, then a ſecond, then a third; and this third it is you are to cut again in the ſame manner as was ſaid before. And you muſt be careful to cut theſe third Knots, without ſtaying for the ſhooting of the 4*th* or 5*th* one. You will ſee out of every Knot come forth Arms or Branches like to the firſt, ſpoken of before; and it is at thoſe Arms, that the *Melon* will be produced. And they will be good, if the Foot or Root be well nouriſhed in good Earth, and cheriſhed by a good Hot-Bed and the Sun. But let the Foot of the *Melon* never paſs into the Dung, nor the Earth be watered but moderately, when you ſee it grows too dry, ſo as the Shoot might thereby ſuffer; which yet you muſt not delay till it happen, leſt the Remedy come too late. I water twice or thrice a Week in very hot Weather, and that about Sunſet; and I cover my *Melons* with a Straw-Mat from 11 in the Forenoon, to 2 in the Afternoon, when the Heat of the Sun is too violent, and too quickly conſumes that little Moiſture neceſſary for the Root. And when it raineth, I cover alſo my *Melon*-Garden, leſt too much Wet hurt my Fruit. *Fig.* 159.

If the Root produce too many Branches or Arms, cut away the weakeſt of them; and leave none but 3 or 4 of the ſtrongeſt and moſt vigorous, and ſuch as have their Knots neareſt to one another. When I tranſplant my *Melons* from the Nurſery-Bed, I put commonly 2 Roots together, except I find one very ſtrong; which I then plant alone, cutting from it neither of the Branches that ſhoot from each ſide (marked 7. 7.) betwixt the one Ear and the Leaf before ſpoken of. But when I join two Roots together, I quite cut away both the Branches that ſhoot from the two Ears, ſtanding one over againſt the other, to avoid the diſordering abundance of Branches; which alſo would wrong the Foot.

The *Melons* being knit, I leave but two of them upon each Foot; chuſing thoſe that are beſt placed, and next to the firſt and principal Stalk, that is to the Heart of the Foot. I alſo take care, to leave none but fair ones, and ſuch as have a ſhort and thick Tail. The Foot alſo of your *Melon* muſt be ſhort, well truſſed, and not far diſtant from the Ground. *Melons* of a long Stem, and having the Stalk of the Leaf too long and ſlender, are never vigorous; and cannot yield good *Melons*.

It happens ſometimes, that at the very firſt, there ſhoot out, from between the two Ears, two Leaves, tho' I above ſpoke but of one: But this happens but ſeldom, and when it does, ſuch two Leaves muſt be reckoned but for one Knot; afterwards there will ſhoot out a ſecond, then a third, *&c.* and ſo on to 25 or 30, if you be not careful to cut in time. And it is at the Extremity of thoſe Branches ſo diſtant, that Melons will grow: But they cannot be good, becauſe they are ſo far from the Place, which affords them their Nouriſhment.

I muſt not forget to tell you, that from the midſt betwixt the two Ears, and the two firſt Leaves, there ſhoots out yet one Branch more, which ought to be kept if vigorous, but cut if weak.

He that is curious muſt every Day walk often in his Melon-Garden, to cut off all the Branches which he ſhall obſerve to be uſeleſs or hurtful.

n.46.p.983. Whenever you have a Melon, which comes well knit on a Branch, you muſt not fail to cut away the reſt of that Branch, on this ſide of the Fruit: To the end that all the Nouriſhment, that would have been diſperſed into the whole Branch, may paſs into that Fruit, which is found at the Extremity of the Branch; taking care notwithſtanding, that the Fruit be covered with ſome Leaves of the other Branches, for its better Growth under the Shade, in thoſe Parts where it is very hot.

There commonly need no more than forty Days from the time of a Melon's knitting to that of its Ripeneſs.

For the keeping of the Seed, you muſt take no other Seed but ſuch as is found in that Part of the Melon, which hath been towards the Sun: And at the ſame time you eat the Melons, you muſt well clean ſuch Seeds, and rub them with a Linen Cloth, until they be very clean and dry; then put them up in ſome convenient Cloſet till Seed-time.

Remember not to eat the Melons but ſome twenty-four Hours after they have been gathered; putting them in the mean time in a dry Place, neither too hot nor too cold, and free from any dry Scents, good or ill.

Obſerve alſo, to gather them ſeaſonably, when they are neither too ripe nor too green, which you may know by their yellowiſh Colour, and by their Tail commonly ſplitting, and their Smell. A Melon ordinarily requrieth one Day from the time of its being ſmitten, to that of its being gathered. I call that the time of its being ſmitten, when it begins to ſhew its being ripe by a little yellowneſs appearing in ſome part or other of it. A Melon that ripens too faſt, is never good, ſuch a Ripeneſs not being a good one, but proceeding from the poorneſs or ſickneſs of the Foot, which maketh it thus turn ſuddenly.

The Melon muſt be full, without any Vacuity, which, you know, is diſcerned by knocking upon it, and the Meat muſt be dry, no Water running out: Only a little Dew is to appear, iſſuing out of the Pulp; which muſt be of a very Vermilion Colour.

Trouble not yourſelf to have big Melons, but good ones. Thoſe who covet great Melons, may have their Deſires, either by ſowing Seeds of the great Kinds, or by much Watering others. Which Watering is a thing, wherein great Care and Diſcretion is to be uſed. You may judge of the neceſſity of Watering by the Vigour which is required in the Foot and Leaves, without which the Fruit cannot be good for want of good Nouriſhment.

Dog-Mercury; *By Mr.* T. M. *n.* 203. *p.* 875.

XIV. 1. About three Weeks ago the Wife of one *William Mathews* near *Salop* gathered ſome Herbs, and (having firſt boiled them) fried them with Bacon for her own and her Family's Supper. And after they had been about two Hours in Bed, one of the Children (which is dumb, and about ſeven Years old) fell very ſick, and ſo did the other two preſently after; which obliged the Man and his Wiſe to riſe, and take the Children to the Fire, where they vomited and purged, and within half an Hour fell faſt aſleep. They took the Children to Bed as they were aſleep, and they themſelves went to Bed too, and fell faſter aſleep than ever they had done before. The Man waked the next Morning about three Hours after his uſual time, went to his Labour at Mr. *Newport*'s, and ſo by Strength of his Conſtitution carried it off: But he ſays he thought his Chin had been all the Day in a Fire, and was forced to keep his Hat full of Water by him, all the Day long, and frequently dipped his Chin in it as he was at his Work. The Woman wakened a while after her Huſband, and being forced to it, got up to look after her little Family Concerns: But ſhe was very ſick, and continued ſo till within theſe few Days, ſince which ſhe is very well recovered. One of their Children ſlept from that Night (which was *Thurſday* three Weeks) till *Monday* Evening following (and then having juſt only opened her Eyes and made two Sprunts, without ſpeaking one Word) died immediately. While ſhe was aſleep, Endeavours were uſed to waken her, but in vain. The other two Children ſlept about twenty-four Hours, and upon their waking fell a vomitting and purging again, which I think ſaved their Lives. *Mathews* told me he never eat ſo pleaſant an Herb in his Life: But it is obſerved that the Cattle never browſe it. It is branched and ſeeded like Spinnage or Mercury, but leaved rather like Lakeweed; the leaves are dented too.

By Dr. Sloan, *ib. p.* 876.

2. Mr. *Will. Baxter* did me the Favour to ſend for a dried Sample or Specimen, and it proves to be *Dog-Mercury*; the Stalks, Leaves and Spikes agreeing exactly in every thing with thoſe of *Dog-Mercury*, or *Mercurialis perennis repens*, *Cynocrambe dicta*, *J. R.*

Hemlock, by Dr. Nath. Wood, *n.* 231. *p.* 636.

XV. A Gentleman of my Acquaintance having a Horſe which was troubled with that ſtubborn Diſeaſe they call the *Farcy*, employed ſeveral uſually efficacious Medicines unſucceſsfully. At length being in a Place where grew a great Quantity of *Hemlock*, he obſerved the Horſe began to feed thereon greedily, eating it up. On which within three or four Days his Sores dried up, and he recovered very faſt. From whence it appears, that the Leaves at leaſt of *Hemlock* are not noxious to ſome Animals, but rather ſalutary. The Seeds alſo, ſome Birds, as in our Obſervation Buſtards, will greedily eat.

A poiſonous Root like Hemlock, *by Dr.* Nath. Wood, *n.* 231. *p.* 634.

XVI. 1. A certain Woman near *Kilkenny* in *Ireland* eating by miſtake ſome Root, I ſuppoſe of common *Hemlock*, among Parſneps, was immediately ſeized with Raving and Madneſs, talked obſcenely, and could not forbear Dancing. Thus ſhe continued for ſome time, till at length ſhe was taken with *Epileptick* Fits: Of which Diſtemper being committed to my Charge, ſhe was ſoon cured by the common Method; and has now for ſeveral Years lived in perfect Health. What Quantity ſhe eat is not known: But a piece of *Hemlock* Root was found on her Trencher.

By Mr. J. Ray, *ib. p.* 635.

Hiſt. Plant. Tom. 3. p. 181.

2. I am in ſome doubt whether it was really the Root of *Hemlock*, which this Woman did eat, and which had this Effect upon her, and not ſome other: Becauſe, 1. *Jo. Bauhine*, relating two parallel Stories of the effects of Roots which were taken for Parſneps, is of Opinion that they were the Roots of Wild-Cicely, *Cicutaria Vulgaris*, or *Myrrhis Sylveſtris*: Becauſe (ſaith he) the Roots of it are more like to Parſneps, than thoſe of *Cicuta* or *Hemlock*. 2. Mr. *Ja. Petiver* aſſured me, that he ſaw one Mr. *Henly* eat 3 or 4 Ounces of *Hemlock-Root* without the leaſt Harm: Whereupon he himſelf was encouraged to do the like, eating about half an Ounce. They taſted ſomewhat like the Root of *Seleri*, or Sweet-ſmallage: And he perceived no ill Effect, or Inconvenience from the eating of them. 3. The common People generally believe that the Roots which cauſe theſe Symptoms, are no other than old Parſneps, which have continued ſome Years in the Ground; and therefore call them *Madneps*.

Hemlock-Water-Dropwort; By Mr. Er. Vaughan, *n.* 238. *p.* 84.

XVII. 1. Eight young Lads (about 30 Years ago) went a Fiſhing to a Brook near *Clonmell* in *Ireland*, and there meeting with a great Parcel of *Œnanthe Aquatica Succo Viroſo* (in *Iriſh*, *Tabow*) they miſtook the Roots of it for *Sium Aquaticum* Roots, and did eat a great deal of them. About 4 or 5 Hours after going home, the eldeſt of them, who was almoſt of Man's Stature, without the leaſt previous appearing Diſorder or Complaint, on a ſudden fell down backwards, and lay kicking and ſprawling on the Ground: His Countenance ſoon turned very ghaſtly, and he foamed at the Mouth. Soon after 4 more were ſeized the ſame way, and they all died before Morning; not one of them having ſpoken a Word from the Moment in which the venenate Particles ſurprizing the *Genus Nervoſum*. Of the other three, one run ſtark-mad, but came to his right Reaſon again the next Morning: Another had his Hair and Nails fallen off; and the third (who is my Brother-in-Law, and from whom I had this Account) alone eſcaped, without receiving any harm. Whether he eat leſs of this fatal Root, or whether his Conſtitution, which is to this Day very athletick, occaſioned it, I cannot tell. Though I am of Opinion that his ſpeedy running above 2 Miles home, after that he ſaw the firſt young Man fall, together with his drinking a very large Draught of Milk, warm from the Cow, in his Mid-way, were of ſingular Uſe to him. For his violent Sweating did doubtleſs expel and carry off many of the venenoſe Particles, and had a better Effect than perhaps the beſt of our *Alexipharmicks* (which you know are generally *Diaphoretick*) might have produced in this Caſe. Beſides, I believe, the Draught of warm Milk did act its part, by involving the acid or acrimonious poiſonous Particles, and rendring them unactive, and preventing their ſeizing the *Genus Nervoſum*, till they were expelled *per Diaphoreſin*.

There was alſo a *Dutchman* about two Years ſince, within eight Miles of *Clonmel*, poiſoned by boiling and eating the Tops of this Plant ſhred into his Pottage. I believe, he took it for *Apium Paluſtre*, which its Leaves much reſemble.

2. Several parallel and no leſs tragical Hiſtories of later Date, of the miſerable Deſtruction of divers Perſons, by the eating of the Roots of this pernicious and deleterious Plant, I find recorded by *Jac. Wepferus*, and in the *Miſcellanea Curioſa, Dec.* 2. *An.* 6.

By Mr. Ray, *ib. p.* 86. *De Nox. Cicutæ Aquat.*

XVIII. Between *Penzance* and *Marketjew* in *Cornwall*, on the ſandy Shore grows Abundance of *Papaver Corniculatum Luteum*, or *Horned Poppy*, with a yellow Flower, vulgarly called in *Hampſhire* and *Dorſetſhire*, *Squatmore*, or *Bruiſe Root*, (as I was there informed) where they uſe it againſt Bruiſes external and internal. One *Charles Worth*, dwelling at the Half-way Houſe between *Penzance* and *Marketjew*, cauſed a Pye to be made of the Roots of the ſaid *Poppy*, ſuppoſing them to be *Sea-Holly* or *Eringo Roots* (for they had made Pyes thereof, which were very pleaſant to them) but on the eating of the aforeſaid Pye, whilſt hot, was preſently taken with ſuch a Kind of *Delirium*, that he called for a white earthen Chamber-Pot, and after having purged by Stool into it, he broke it into Pieces, and bid the By-ſtanders to ſave them, for they were all Gold. The Men and Maid-Servants, having alſo eat of the ſame Pye, became delirious, and fanſied that moſt what they ſaw was Gold. A Child in the Cradle having alſo taſted of the Pye, was much doſed, and turned its Mouth to and again. And thus they continued for ſome Days, and then became well.

The Horned Poppy; By Mr Ja. Newton, *n.* 242. *p.* 263.

Perhaps the yellow Colour of the Flowers running in their Minds, which the eating of the Roots had now depraved, might beget that Idea of Gold in them.

XIX. There are two Sorts of the *Helmontian Laudanum*; the one uſed by the elder *Helmont*, the other by his Son. The former was a great Secret communicated to me by an expert Chymiſt about fifteen Years ago: Which becauſe I have not leave to publiſh, meeting about two Years ago with that obliging and ingenious Perſon *F. M. Baron Van Helmont*, Son to the famous *Johannes Baptiſta*, I obtained from him by Word of Mouth, ſome Directions about the *Laudanum* he uſes; which though he confeſſed, and I ſoon perceived, to be differing from his Father's, yet he ſeemed to think it not inferiour and more parable.

The Helmontian Laudanum; *By Mr.* Boyle, *n.* 107. *p.* 147.

I ſoon after committed it to Writing, leſt it ſhould ſlip out of my Memory, and I had his Permiſſion to communicate it for the publick Good.

Take of *Opium* a quarter of a Pound, and of the Juice of *Quinces* 4 Pound at the leaſt; the *Opium* being cut into very thin Slices, and then as it were minced to reduce it into ſmaller Parts, is to be put into, and well mixed with the Liquor (firſt made Luke-warm) and fermented with a moderate Heat for eight or ten Days, rather more than leſs. Then filter it, and having infuſed in it of *Cinnamon*, *Nutmeg* and *Cloves*, of each an Ounce, or an Ounce and half, let them ſtand three or four Days more; if it be a full Week, it may be ſo much the better. Then filter the Liquor once more, having let it boil a Walme or two after the Spices have been put in. This being done, evaporate away the ſuperfluous Water to the Conſiſtence of an Extract, or to what other Conſiſtence you pleaſe.

Laſtly, Incorporate very well with it two Ounces of the beſt Saffron reduced to fine Powder, or as much Extract as can be obtained from that quantity of Saffron.

According to the Conſiſtence you deſire to have your Medicine of, you may order it ſo, as either to make it up into a Maſs of Pills (in which Form I have cauſed it to be given) or keep it in a liquid Form; but in this latter Caſe the Evaporation muſt have been made more ſparingly, that after the putting in of the Saffron, or its Extract, it may not grow too thick. In this Form the Doſe may be from 5 or 6 Drops to 10 or fewer, according to Circumſtances; and of the Pills a ſomewhat leſs Quantity is required.

The Uſe of Opium *among the* Turks; *By Dr.* Edward Smith, *n.* 221. *p.* 288.

XX. One *Muſtapha Shatoor*, an Inhabitant of *Sediqui*, a Village ſix Miles from *Smyrna*, by Trade a Coffee-Man, about forty-five Years old, a moſt famous *Opium* Eater, told me, that his conſtant eating was 3 Drachms a Day of crude *Opium*, one half of which was his Doſe in the Morning, and the other half in the Afternoon: But that he could ſafely take double this Quantity.

Reſolving therefore to be an Eye-witneſs of what he could do, I provided the beſt *Opium* I could get, and weighed it nicely into Drachms. He came to me at my deſire, at 9 in the Morning, but excuſed his having taken half a Drachm before, becauſe he had not Strength to riſe out of his Bed without it. I laid before him my *Opium* made up in Pills, each weighing a Drachm, and deſired him to eat what he pleaſed. He took one Drachm and a half, making it up in three Pills, and chewing it with a little Water: He commended the *Opium*, but was not willing to eat more at a time, and I would not preſs him for fear of Accidents. He ſtayed with me about half an Hour after he had eaten the *Opium*: The viſible Effects it had upon him were to make his Eyes ſparkle, and to give a new Air of Life and Brightneſs to his Face. He told me that he was extremely refreſhed by my Entertainment; and I found him half an Hour afterwards labouring heartily at cleaving Wood to burn. At three in the Afternoon he came to me again, and took the ſame Quantity as in the Morning, and appeared after it with the ſame Symptoms. He ſays, that it has always the ſame Effects, giving him Vigour and Spirit, and is now become as neceſſary to him as any other Part of his Suſtenance; that it makes him fitter for Procreation, for he has many Wives and Children; that it never affects him with Sleep and Drowſineſs, but rather hinders his Repoſing, when he happens to take too much of it; that he entered upon this Practice twenty-five Years ago, beginning with the bigneſs of a Grain, and ſo training up Nature gradually to larger Quantities; and that the Want of it, and the Deſire of taking more, grows daily upon him.

The Alteration and Impairment which this Cuſtom hath produced in him are Weakneſs, his Legs being ſmall, his Gums eaten away, ſo that the Teeth ſtand bare to the Roots, his Complexion very yellow, and appearing older by twenty Years, than he really is.

Opium is commonly taken by the Meſſengers in *Turkey*, who are employed in making quick Diſpatches; it is generally part of their Proviſion, they take it when they find themſelves tired, and it gives them Strength and Spirit to proceed. I had the following Relation of one of them, that coming from *Conſtantinople* to Mr. *Samuel Barnardiſton*, a Merchant of *Smyrna*, at entering into the Gentleman's Houſe, he fell down for dead; at which, when the whole Houſe was ſurprized and concerned, one of the Servants rightly judging that this Fainting away was occaſioned by the Stock of *Opium* laid in for his Journey being ſpent, forced a little of it into his Mouth, and by this Means he preſently recovered, and acknowledged the Servant had been his Phyſician.

The *Turks* uſe *Opium* made up with ſomething that renders it palatable, at their Feaſt called *Biram*, to make them cheerful; which may be one Reaſon of its prevailing ſo much: For finding it then entertains them with pleaſing Fancies, they are tempted to continue it, and ſo the Uſe becomes neceſſary, and grows upon them.

Mackenboy; *By the Bp. of* Cloyne, *n.* 243. *p.* 294.

XXI. The famous *Iriſh* Herb called *Mackenboy*, or *Tithymatus Hibernicus*, is reported by the Natives to be ſo ſtrong a Purge, that even the carrying it about one in their Clothes is ſufficient to produce the Effect. But Dr. *Mullen* has lately proved this Story to be falſe, by carrying its Roots for three Days in his Pocket, without any Alteration of that Sort.

The Snake-Roots; *By Mr.* J. Banniſter, *n.* 247. *p.* 467.

XXII. The *Piſtolochia*, or *Serpentaria Virginiana* hath a buſhy Root, conſiſting of a number of ſmall Strings of a yellowiſh Colour, and hot aromatick Scent and Taſte: Thence grow one or two ſmooth, at leaſt very little hair Stalks; round, and moſt commonly upright, not ſquare nor trayling. The Leaves grow alternately on this Side and that, one at a Joint or Knee: They are thin, long and pointed, coming like a Heart at the Foot-Stalk; a little hairy above, and rough with many protuberant Veins underneath; and in handling they ſtick a little to the Fingers. Near the Ground grow one or two hollow Flowers, each upon its proper Foot-Stalk, different in Form from the *Piſtolochia Cretica*, or any other yet known: All whoſe Flowers reſemble a Cow's Horn, the Top growing to the Rudiment of the Seed Veſſel, and the open End cut flaunting like a Drenching-Horn, whereas this of ours terminates with a Heel, which ſupports a broad, round, galerniculated Lip, the Center of which opens into the Hollow of the Flower.

The Lip is of a light ruſſet, or dirty Colour. The Seed-veſſel is hexagonal, ſhaped like a Pear when full grown, near half an Inch in Diameter. It is not an Ever-green, but after the Seeds are ripe, the Leaves and Stalks begin to wither and decay. It flowers in *May*, and its Seeds are ripe in *Auguſt*.

Devils-bit, *by Sir* Tho. Mayerne, *n.* 211. *p.* 166. XXIII. *Succiſa*, or *Devils-bit*, is excellent for Poiſons, eſpecially the Plague, and it is ſo powerful a Sudorific, laying the ſick Perſon, whether of the Plague, or other malignant Fever, on a Bed of that Herb, moderately hot, he ſhall ſweat till they take him off, and much more if he drink of the Decoction, or Juice of the Herb; which in Summer they take all, and in Winter of the Root only.

Alcanna, *n.* 243. *p.* 295 XXIV. *Alcanna* is the Leaf of a Plant, dried and powdered; which when ſteept a Night in Wine, will dye the Nails red.

AloeAmericana; *by Dr.* Merret, *n.* 25. *p.* 455. XXV. *An.* 1556. An *Aloe Americana*, *ſerrato Folio*, being of a pale green Colour, and conſiſting of 11 Leaves, was bound about with a red dry Cloth, and was hung up without Oil, as is uſual, in the Kitchen. It weighed,

		Weight.				*Loſs.*				*Weight.*				*Loſs.*	
		℥	ʒ	℈	gr.	℈	gr.			℥	ʒ	℈	gr.	℈	gr.
Aug.	4	21	6	0	2			*May*	1	20	7	0	0	1	0
Aug.	19	21	3	0	24	3	27	*May*	28	20	5½	0	0	1½	0
Sept.	6	21	1⅓	0	0	1	14	*June*	12	20	4	0	4	2	26
Feb.	20	21	1	0	12	0	11	*July*	1	20	1	0	8	2	18
Mar.	16	21	0	2	0	0	32	*July*	20	19	6	0	1	3	7
April	8	21	0	0	0	0	40	*Auguſt*	4	9	3	0	12	2	40

So that in a whole Year it loſt 2 Ounces, 3 Drams, 24 Grains. The ſucceeding Year, being drier and hotter, it loſt 3 Ounces 2½ Scruples, and more than double in the 6 colder, than the 6 hotter Months. I kept it about 5 Years, and it decreaſed much about the ſame Proportion. And in the Year 1660, hanging it in a cold Garret, it periſhed.

Theſe Obſervations I had about it, that every Year two of the greater Leaves firſt changed Colour, and withered; and in the Spring-time, there grew out two very freſh and green ones, never amounting to the bigneſs of any of the precedent. Inſomuch, that all this time I had the ſame Number of Leaves. And then theſe new Leaves were more freſh and green, and not ſerrated, and thicker alſo in proportion to their other Dimenſions. Whence perhaps it may probably be inferred, *viz.* from the Growth of theſe latter Leaves, that there is a Circulation in this Plant of the *Succus nutritius*: For, how is it poſſible, that the Roots continuing as firm and ſolid as at firſt, ſhould ſupply ſo much Nouriſhment, as to procreate new Leaves, unleſs it were from the Return of the ſaid *Succus*, from the old and decaying Leaves into the Root, and there protruded for the Production of new ones? For all bulbous Roots, as Garlick, Onions, Tulips, and eſpecially Squills, which protrude their Leaves, placed in a Shop or Houſe, have their Roots lighter and more ſpungy; the Leaves being formed out of the Subſtance of the Root, as a Chick out of the *Albumen*: In the mean while, the whole decreaſing in Weight, as in the aforeſaid Aloe.

The Tartarian Lamb, *by Dr*. Hans Sloan, *n*. 247. *p*. 461. *Fig*. 160.

XXVI. Fig. 160, repreſents what is commonly, but falſly, in *India* called the *Tartarian* Lamb, ſent down from thence by Mr. *Buckly*. This was more than a Foot long, as big as ones Wriſt, having ſeveral Protuberances, and towards the End ſome Foot-Stalks, about 3 or 4 Inches long, exactly like the Foot-Stalks of Fern, both without and within. Moſt Part of the outſide of this was covered with a down of a dark yellowiſh Snuff Colour, ſhining like Silk, ſome of it a Quarter of an Inch long. This Down is what is commonly uſed for ſpitting of Blood, about 6 Grains of it going to a Doſe, and 3 Doſes pretended to cure ſuch an Hæmorrage. In *Jamaica* are many *Scandent* and *Tree-Ferns*, which grow on, or to the Bigneſs of Trees, and have ſuch a kind of *Lanugo* on them, and ſome of the Capillaries have ſomething like it. It ſeemed to be ſhaped by Art to imitate a Lamb, the Roots or climbing Parts being made to reſemble the Body, and the extant Foot-Stalks the Legs. This Down is taken notice of by Dr. *Merret*, at the latter End of Dr. *Grew*'s *Muſ. Soc. Reg*. by the Name of *Poco Sempie*, a Golden Moſs, and is there ſaid to be a Cordial. I have been aſſured by Mr. *Brown*, who has made very good Obſervations in the *Eaſt-Indies*, that he has been told there by thoſe who have lived in *China*, that this Down or Hair is uſed by them for the ſtopping of Blood in freſh Wounds, as Cobwebs are with us: And that they have it in ſo great Eſteem, that few Houſes are without it. I have known it much uſed for ſpitting of Blood. But on Trials I have ſeen of it, tho' I may believe it innocent, yet I am ſure it is not infallible.

P. 386.

A ſort of Seeds which clarify Water, by Dr. Hans Sloan, *n*. 249. *p*. 44. Fig. 161. *n*. 45. *p*. 863.

XXVII. I have ſeveral times ſeen a ſort of Seeds, come from the Coaſt of *Cormandel* and *Malabar*, which are there uſed for clarifying Water. They are about the Bigneſs of a ſmall Pea, only broader and flatter, having *Striæ* run from their Center after the manner of the common *Nux Vomica*. The beſt Account I have had of the way of uſing them, was from Dr. *Brown*, who lived in the *Eaſt-Indies* ſome time; he ſays, they rub or grate them on the Bottom of a ſmall earthen Baſon, wherein is contained ſome Water; this Water and Powder is put into a large Quantity of muddy or foul Water, which is by this clarified.

*The true A*momum, *or* Tugus *of the* Philippine *Iſles, by* P. Ge. Gamelli, *n*. 248. *p*. 2.

XXVIII. Upon viewing the bunchy Faſciculus of Flowers of the *Tugus Birao*, or as ſome call it *Caropus*, and taſting its Grape with the Kernel or oblong Seed, and comparing them with the Deſcriptions of the *Amomum* by Botaniſts, I am fully perſuaded that the *Tugus* is the real *Amomum* of *Dioſcorides*.

The *Tugus* is a Plant ſome Cubits ſometimes high, with a Leaf like the Plant *Tagbac*, or *Bagongbonque*, except that on its under ſide, it is covered with a very fine Down; beſides it is more veiny, longer and ſweeter ſmelled. At the Root of the Plant, or the Trunk of the Stalk, from the Pith of the leavy Stalk, there buds out, more like a Bunch of Grapes than of the Flowers of the *Amomum*, a *Faſciculus* of Leaves of about ſix Inches long, adorned with very red Flowers, which are followed by the Grapes ſhooting out into a longiſh Neck, with a ſweet thin Skin, whence being devoured for the moſt part, together with the Seed, by Mice and Birds, it can only be gathered in very ſmall Quantity. Wherefore *Virgil* ſeems to inſinuate that it was formerly very rare, when he ſays that, The *Aſſyrian Amomum* ſhall grow common in the Fields.

Theſe Grapes contain commonly five or ſix reddiſh, oblong, unequal, aromatick *Grains*, or *Kernels*, leſs acrid than *Amuyong*, and more fragrant than the *Cubebs* of the Shops; of which the *Jewiſh* Girls at *Caropi*, uſe to make Necklaces and Bracelets, ſtringing them upon a Thread, either by themſelves, or together with *Pearls* and *Coral*. Some make them of theſe and the Seed of *Abelmoſch*, which they call *Maricom*; ſome of the Seeds of *Gromel*, with them *Tigbi*; ſome with thoſe of the *Red-Cane*, with them called *Ticaſticus*, ſome with the *Saffron-Pea*, which they call *Saga*; as likewiſe with the Seeds of *Amomonti Bodiang*; and thoſe of *Cardamoms*. But the Grains of the *Tugus* they wear about their Necks upon Accout of their grateful Smell; and Experience has likewiſe taught them that theſe Grains are a Preſervative againſt infectious Air, and cure the Bite or Sting of the *Scolopendria*, being chewed and laid upon the Wound. The Root is like that of the *Tagbac* or *Sweet-Cane*, inſipid, white within, and externally covered with reddiſh, ſubodorous Films like thoſe of Onions. I had it wrote to me from *Boronga*, that from the Tops of the Stalks, there grows another Kind of Fruit which is not aromatick; but this I never ſaw. The *Indian Indians* affirmed the ſame to me; but I imagine they were deceived, and had probably taken the Plant *Tacbac* (*Tagbac*) for the *Tugus*.

It is brought into *Boronga*, and the Head of *Pyrana* from other Places of the Iſlands *Samar*, and *Leyte*. And I do not doubt but it is found likewiſe in *Luzona*, eſpecially in the Depths of the Torrents of *Silanium*.

Note, The recent tender Buds of the Flowers of the *Tugus*, in ſome Meaſure repreſent the falſe *Amomum* of *Garcia*, reſembling the *Doves-Foot*. But that nothing might be wanting, I ſend you together with this, a Figure of the Plant; and ſome People will object, that a Cheſnut has as much the Reſemblance of an Egg, as the Leaves of the *Tugus* have with thoſe of the *Pomegranate*, which I willingly grant them. But whatever *Dioſcorides* and *Pliny* have ſaid of the *Amomum*, is only to be underſtood in my Opinion, of the flowery Bunch of Grapes of the *Tugus* turged with Seed; for they were not acquainted with the whole Plant itſelf. For the *Tugus* has a Stalk about a Span high, more or leſs; of a reddiſh Wood, or woody Subſtance, with little Leaves and Flowers like thoſe of the *Pomegranate*, rolling themſelves up in the Form of a Bunch of Grapes, or according to *Barth. Merula*, its Fruit is like a Bunch of Grapes, with Seeds like ſmall Grapes, the outer Covering very aromatick and pungent to the Taſte, of a heating, aſtringent, and drying Quality, with the other Marks of the true *Amomum*, the Plant, as on carefully examining it, reſembling *Doves-Foot* in its Figure, *Joh. Botero Benes*, ſays the *Amomum* comes from *Turcomania*, a Province of *Armenia*.

The Abmella from Ceylon; by Dr. Horton, *n.* 257. *p.* 365.

XXIX. There is an Herb called *Abmella* by the Inhabitants of *Ceylon*, which of late is become very famous for the *Lithontriptick* Quality aſſigned to it. Whether it is found any where elſe I do not know, but I reared it when I had the overſeeing of the Phyſick Garden at *Amſterdam*. It ſends forth Flowers from the Tops of its Stalk like the *Chryſanthemum Curaſſau with the high Stalk and the Orange Flowers*, *Par. Bat.* Its Seed is forked, and the Stalks ſquare, covered with a prickly kind of Down like that of the Nettle, or dead Nettle; whence it plainly appears, that it ought to be referred to a Species of *Hemp*, which *Ciſalpinus* calls forked, and after him *Tournefort*; and perhaps not improperly, to the *Indian Lithontriptick Hemp*, or *Bidens with the Leaf like the dead Nettle.*

Nux Pepita, *or* S. Ignatius's Beans, *by Dr.* Sloan, *n.* 349 *p.* 44. Fig. 163. n. 150. *p.* 87.

XXX. 1. *The Nux Pepita*, or *St. Ignatius's Bean*, is about the Bigneſs of a Nutmeg, and triangular. This Fruit is very much eſteemed in the *Philippine* Iſlands, for the Cure of many Diſtempers.

2. 1. This Fruit has the Vertues of that Metal which we call *Tumbaga*, compoſed of that which is called *Ilingo*; it is good againſt Cramps and infected Blaſts, and againſt that Kind of Spaſm which we call *Sotan*.

2. It is good for bringing up any Kind of Poiſon, if the Raſpings of it are drank in ſomething cold, as alſo againſt the Bites of venemous Creatures, if they are applied to the Wound.

3. It is likewiſe of Service in Spaſms of any particular part, if you apply the Raſpings of it to the Part affected.

4. Theſe Raſpings likewiſe ſtop a Bleeding, applied to any Wound, and laſt Year, *viz.* 1692, being given to a Woman to drink for a violent Flooding, ſhe was cured of that Complaint.

5. It alſo cures Fevers; for I was preſent the ſame Year, when it was given to a Child to drink who was ill of a violent Fever, and immediately after the Diſeaſe went off.

6. It aſſiſts Women in Labour, ſo as to render the Birth more eaſy and expeditious.

7. I come at laſt to talk of it from daily Experience. And it is of ſurpriſing Efficacy in every Repletion and Crudity of the Stomach, as alſo in a Dyſentery and troubleſome Teneſmus.

The Patient may divide each Nut into three Parts, and when he finds he has need of it, let him hold one of them in his Mouth for a Quarter or Half an Hour, and ſwallow his Spittle, and afterwards let him drink two or three Ounces of cold Water, and you will ſee its Effects.

Or, Let him take a Fragment of the hardeſt ſhelly Part of it, and into the Hollow of that pour a little cold Water, rub the Fruit in it, and put by the Water in a proper Veſſel with ſome Raſpings; let this be repeated three or four Times, till he has two Ounces of that Concoction and the Lotion of the teſtaceous Fragment and the Nut or Grain of the Shrub, and then let him pour this off and drink it.

Alſo, If the Nut is divided into Pieces, rubbed with Oil (eſpecially of Olives) and the Oil is drank, applied to Wounds, or rubbed upon Limbs that are taken with Cramps, it is medicinal as above.

By P. Geo. Camelli, ib. p. 88. *Fig.* 164.

3. *Catolongay*, which others call *Cantara*, is a Plant bearing the true *Nux Vomica* of *Serapion*, and climbs winding up upon the higheſt Trees. The Trunk is woody, light, porous, ſometimes as thick as one's Arm, and its Bark is tough, thick, and of an Aſh-Colour. Its Leaves are large, ſtringy, bitter, and almoſt like the *Indian* Leaf. The Flower is like that of the *Balauſtine*, followed by a Fruit larger than a Melon, with a very fine outer Skin, ſhining, ſmooth, and of the Colour of Alabaſter, under which there is a Kind of Shell as it were, of a ſtrong Subſtance. Within this Shell is contained a yellow, ſoft, bitteriſh Pulp, like that of the Fruit *Mango*, in which lie the *Nuces Vomicæ* of *Serapion*, frequently to the Number of twenty-four, which when recent, glitter with a Silver Down, a little leſs than Acorns, but unequal and variouſly ſhaped. Theſe the *Indians* call *Iſagur*, and *Mananaag*, that is victorious; the *Spaniards* the *Kernels*, or *Pepita* of *Byſayas*, or *Cathalogan*, and others *St. Ignatius's Beans*. When dried, they are about the Size of a Filberd, or rather a little larger, knotty, very hard, diaphanous, and as it were horny, of a bitterer Taſte than the Seed of the Citron, between a white and a blue Colour, as *Serapion* likewiſe obſerves.

There are a great many, I do not know from what Principle, who put the Nut *Iſagur* into a Bag of the Fruit *Salag-ſalag*, and hang it about their Necks; and by this Means they imagine they are preſerved from all Poiſon, Plague, Contagion, Magick Incantations, and Philters, eſpecially from that Poiſon which they call *Saptum*, and which they ſay only kills by puffing up the Body, and even from the Devil himſelf.

This *Cb. Miralles* affirms in his Collections, ſaying that they have not only a Vertue of driving away Diſeaſes, but alſo of reſiſting evil Spirits in a ſpecial Manner; for by theſe Nuts the *Magi*, called *Barange*, are diſturbed, diſquieted, and moſt heartily ſweated, as if they were engaged in ſome hard Taſk full of Dangers and Difficulties: Which he adds, he had learned by Experience; and beſides, had it affirmed by others who had ſeen it, and whoſe Word he could very well rely upon. Whence he ſuſpects that theſe *Barange*, or miſchievous Simplers, are in Compact with the Devil: Eſpecially as it is reported, that thoſe wicked Phyſicians, oblige thoſe who want to be inſtructed in the Knowledge of Simples, to put to Death the nigheſt of their Relations.

There are ſome who ſay, that *Alexius Lopez* in *Guiguan*, and *Peter Oriol*, and others, being provided with this Nut beforehand, were thereby preſerved from the abovementioned *Soptum*, or blowing up by Poiſon, with which the malevolent *Indians* kill thoſe they have a Spite at. They take, as is commonly ſaid, the Poiſons of the abovementioned Herbaliſt, which they are very familiar with, and put them in one Side of the Mouth, and in the other Cheek *Contrayerbas*, as they call them, that is Antidotes, to prevent their being poiſoned. Theſe Things being held in the Mouth artfully, and with a diabolical Dexterity, they breathe upon their Enemies, or thoſe they hate, with a poiſonous Breath like Serpents, whereby they are immediately ſtruck down to the Ground, and die, unleſs prevented by this Remedy which they have found out, *viz.* the Nut. They add too, that if any one carries this Nut about with him, the Perſon who offers to infect him with his poiſonous Breath will ſuffer, as happened to the *Indian* that in a Shew of Friendſhip, attempted treacherouſly to take away the Life of *Alexius Lopez*, who chanced accidentally to have his Nut about him; which firſt gave Occaſion to the *Spaniards* to obſerve the Vertue and Efficacy of *Iſagur*. But how *Iſagur* naturally, as ſome will have it, can repel the Vertue of a Poiſon acting at a Diſtance, I leave others to judge.

I once gave a Scruple of the Powder of *Iſagur* to *Vincentius Olzina*, who was of a melancholick Conſtitution, and troubled with Indigeſtion, a Diarrhæa, frequent Vomitings, ſour Belchings, and a great deal of Wind. He had no ſooner taken it than he was ſeized with an univerſal Tremor, which continued for three Hours, together with an Itching, and terrible convulſive Twitching, ſo that he could not ſtand, but they were ſtill more violent and troubleſome in his Jaws, ſo as to force him to a Kind of Laugh. The Pulſe in the mean while ſuffered no Alteration, he had no Vomiting, nor any ſubſequent bad Symptoms; and afterwards he found himſelf ſomewhat relieved by it.

Johannes Oſeta ſuffered the ſame Kind of Tremor, and ſpaſmatick Convulſions as *Vincentius Olzina*, together with a great Tightneſs in the Thorax, Giddineſs, Faintiſhneſs, and cold Sweats. This Man who was of a melancholick, hippiſh Conſtitution, and very deſirous of Health, had ſwallowed an entire Nut freſh taken out. I relieved him by giving him Oxymel and Oil in warm Water, which made him throw up a great deal of viſcid Phlegm together with the Fragments of the Nut.

Joachinus Aſſim, after taking a third Part of a Nut, was ill upwards of three Hours of the ſame Complaint with *V. Olzina*, and *Johannes Oſeta*. But beſides the Contractions and involuntary Motions he felt a Senſe of Crawling, eſpecially about his Head. Laſtly, *A. Varaona*, *A. Girau*, and others, ſuffered the ſame Symptoms from the ſame Cauſe.

But the common People exhibit the Nut *Iſagur* indifferently in every Complaint, without any Regard either to the Time, Diſeaſe, Age, or even the Doſe; and they tell a great many wonderful Things of it, extolling its good Succeſs, and concealing the bad: And there is no doubt, but ſometimes from ſuch a violent Irritation of the animal Spirits, and Alteration of the Humours, occaſioned by this Nut, ſome morbid, heterogeneous Particles muſt be purged off. And thus the Humours being reſtored to a better Craſis, the Health will be reſtored.

The common Way of uſing it is by ſteeping it whole for a little while in hot Water till it becomes bitter, and then giving the Infuſion. Some give a ſmall Quantity of the Powder in Subſtance. Some make the Patient ſwallow one or two little Bits of it; and ſome hang a whole Nut, by way of a Charm, about the Neck.

For the moſt Part it occaſions Vomitings, and ſometimes it purges; on the *Spaniards* it almoſt always cauſes ſpaſmodick convulſive Motions, but not on the *Indians*. By way of Antidote againſt Poiſon, and in inordinate Tumults of the Spirits, it is to be taken whenever the Caſe requires it. But in other Accidents or Diſeaſes, it is beſt in the Morning when the Stomach is empty; unleſs it is given by Way of a Vomit, and then it does better an Hour or two after eating, to the Quantity of ten Grains, mixed with ſome other gentle Emetick.

There are many who carry a whole Nut about with them, and affirm (I refer you to the Authors for the Truth of it) that it preſerves them from the Plague, Magick Incantations, Philters, Septum, or the Breath tainted with venemous Herbs, as alſo from I don't know what Contagion of the Air, which the *Spaniards* call *Malaire*, and *Paſmus*, that is being ſtunned, and the *Indians Sautan* (from which they ſay they are likewiſe preſerved by black Coral, the Hoof of the Rhinoceros, Dumbaga, Jngo, and the Shell of the Tortoiſe;) but it ſeems rather to be a kind of Catalepſy; for when they are ſeized with it they fall down as if ſtruck with a violent Pannick, deprived of their Senſes and Speech, they are ſtupified, and frequently grow ſtiff, as if they were really dead; but by a revulſory, and cruel Scourging of their Legs and Arms, whereby the Blood is collected there, and then evacuated by Scarifications, they are brought to themſelves and cured.

F. de la Zarza informs us, that a Piece of the Nut, or a little of the Raſpings of it, is very good againſt the Bite of the Viper *Baſul* (a Kind of Canker-worm, hairy and noxious, producing a violent Itching to the Touch) or of other venemous Animals; or applied to a Wound by an Arrow, or any other poiſoned Inſtrument, adhering to it like the Snake-Stone, and extracting the Poiſon. Others recommend the Powder in an Hæmorrage of the Noſe, and to ſtop a Bleeding from a Wound.

In the *Malviento*, *Malaire*, *Sautan*, and *Paſmus* (a Kind of *Catalepſy*) *Stupor*, *Apoplexy*, *Palſy*, *Lethargy*, *Epilepſy*, *Aſthma*, obſtinate and ſuffocating *Catarrh*, *Tooth-ach*, and other *Defluxions*, a little Bit muſt be put upon the Tongue, to increaſe the Diſcharges of Saliva; for by this Means the Head being purged of a Quantity of viſcid Phlegm, the Patients very often find themſelves relieved, and frequently at the Point of Death, if I may ſay ſo, are recovered.

The Powder, Infuſion, or Oil below deſcribed, is very much commended in Tertian and Quartan Agues. When there is Danger from Poiſon, or the abovementiond *Septum Buyaſſo* (that is *Buyo*, or *Betele*, a deadly Compoſition, made with the Seeds I imagine of the Thorn-Apple, or ſome ſuch Narcotick, which if it does not kill the Perſon, makes him dull, confuſed, ſtupid, torpid, and as it were ſtunned:) I ſay, ſuch as have ſwallowed or chewed this Compoſition, I have known cured by this Oil, as alſo where there was a Suſpicion of having eat the noxious *Botele Sardinæ*.

I have likewiſe found it efficacious in promoting Urine, the Menſes, and Lochia when they were ſuppreſſed, in facilitating difficult Births, bringing away the Secundines, expelling a dead Child, and Worms. They gave it beſides in Cholicks, Indigeſtions, Crudity of the Stomach and a bad Concoction, Diarrhæa, Teneſmus, and Obſtruction of the Liver, and Spleen, as alſo in all the Diſeaſes abovementioned.

But the Oil of *Iſagur* prepared ſimply by Infuſion is a moſt efficacious Emetick and cures the ſame Complaints with the Nut itſelf. I was told by a Perſon of great Veracity, that at the Preſence of the Magician *Barang* it effervеſced and came running out of the Veſſel. The ſame Thing is affirmed by other Authors.

Others again in order to make this Oil more efficacious, compoſe it of *Iſagur*, *Tambal de Garigara*, *Tambal de Sangil*, *Tambal de Bornei*, *Salag-ſalag*, *Camæſa*, *Manungal*, *Alagao*, *Salibutbut*, *Tambaliſay*, *Marbar Molavin*, *Borogtongon*, *Palyaccan*, *Panambac*, *Pancoro*, *Nolalaſſon*, *Bagatapon*, *Oringun*, and other Things: This is commonly called *Jazoite de Tambal*, *viz.* from the Emetick Bark *Mananangtang*; it purges violently both upwards and downwards, and its Doſe is from one Ounce to two.

The *Lignum Sanctum* of *Luzo* is a good Succedaneum for *Guajacum*; farther it helps the Concoction, and excites the languid Appetite. *N. B.* It cannot be given to pregnant Women but it occaſions Abortion.

The Snake Wood of Manungal, and the Decoction, is good againſt all Poiſons, and the Bites of venemous Animals. It is febrifick and Anti-Aſthmatick, opening inveterate Obſtructions, and reſtoring a loſt Appetite. It cures a Jaundice in eight Days taken in the Morning. It expels Worms, and mitigates cholick Pains. A Decoction of two Ounces of it, uſually gives five Stools.

The Vomiting Bark Mananangtang, is given in Powder, from one Scruple to four. It purges off pituitous, viſcid, and bilous Humours, both by Vomit and Stool; and hence it is of great Service in Fevers, Repletion of the Stomach, or a Turgency of viſcid Humours, Cachexy and Dropſy. It is more effectual againſt Poiſons, and for bringing away Worms than the Decoction of *Manungal*.

4. There is a Bean called *St. Ignatius's*, which is lately come into Vogue. It is called likewiſe *Iſagur*, *Faba di St. Nicolas*, and *de Cava Longa*. It is a very bitter Seed, having no Reſemblance of a Bean, as you may ſee from the Seed itſelf. It is principally uſed for promoting Sweats, and curing of Fevers; as alſo in Looſeneſſes, Bloody-Fluxes, Cholick Pains, Convulſions, and the Epilepſy; and externally for the Itch. Its alexipharmick Virtues are alſo very much extolled. It comes from the *Philippine*, as they are called, and the neighbouring Iſlands. Its Species is not known; only I have been informed by *D. Rafaele de Roa Hiſpana*, a very learned Man, who lived long in thoſe Iſlands, that it is a Plant of the convolvulous Kind climbing up upon the higheſt Trees, and bearing Fruit about the Size of a Pomgranate, in which are a great many Seeds, from which falling off new Plants ſpring up.

By Dr. Hotton, 357. *p.* 365.

Cherries recovered, tho' almoſt wither'd, by *Dr.* Chr. Merret, *n.* *p.* 455.

XXXI. I had three *May* Cherry-Trees, planted in a rich Mould, which lay to a South Wall, ſhaded from the Sun by a high Building, till the beginning of *March*; when being high, and ſhining ſomewhat fiercely upon them, the Fruit conſtantly wither'd. But this Year, 1665, the Seaſon being very hot and dry, I barred the Roots of one of them, by making a Hole about it, and watered it every Morning and Evening with about a Gallon of Water, for about a Fortnight before the Cherries came to Redneſs; and the Fruit was full and good. The other two Trees, left without this ordering, had moſt of their Fruit withered, having only Skins and Stones. Then I made a Hole round about one of the other Trees, and fed it with Water daily, as the former: In a Week's time, thoſe that were quite withered fell off, and the reſt that were not ſo, grew and increaſed exceedingly; the other Tree, that was not uſed after this manner, had not any of its Fruit come to Perfection.

The Sorbus Pyriformis; *By* Mr. Edm. Pitt, *n.* 139. *p.* 978.

XXXII. I have lately found the *Sorbus Pyriformis* of *Lobelius*, or *Sorbus Procera* of *Bauhinus*, growing wild in a Foreſt of *Worceſterſhire*. It reſembles the *Ornus* or *Quicken Tree*; only the *Ornus* bears the Flower and Fruit at the End, this on the ſides of the Branch: Next the Sun, the Fruit hath a dark red Bluſh; and it is about the bigneſs of a ſmall *Juneting Pear*. In *Sept.* it is ſo rough as to be ready to ſtrangle one: But being then gathered, and kept till *October*, they eat as well as any Medlar.

By . . . ib. *p.* 979.

2. Perhaps a Verjuice made of this Fruit, either ground with Crabs, or Grapes, or if plentiful, alone, would, being kept for ſome time, prove one of the beſt *Acid-Aſtringent Sauces*, that Nature affords.

A double Pear, by . . . *n.* 260. *p.* 470.

XXXIII. The laſt Autumn I met with a double *Pear*, one part growing over, and being fixt in the other; not unlike an Acorn in its Cup: From the Edges of the lower *Pear* there grew up 5 Leaves of various Magnitude, at diſtances almoſt equal from each other. The largeſt of them was one Inch long, half an Inch broad; as large again as the ſmalleſt Leaf. Theſe Leaves grow out of the Skin of the lower *Pear*, and had no Fibres riſing from the carnous part of it. One of the Leaves, the largeſt of them, had a Fibre of the bigneſs of a ſmall Hair, continued from the place where the Leaf riſes down, juſt within the Skin and looſe from it, to the *Pedunculus*. The outer Coat of the *Pedunculus* was continued to the Skin of the lower *Pear*, and this Skin to that of the upper *Pear*. The inner Fibres of the *Pedunculus* go thro' the lower up into the upper *Pear*, and diſperſe themſelves in it. The upper Part was twice as big as the lower, and had ſeveral Kernels in it, but the lower none at all.

An unuſual way of propagating Mulberry Trees, *in* Virginia, *for Silk Work*; *By* . . . *n.* 12. 201.

XXXIV. I have planted here (in *Virginia*) 10000 *Mulberry-Trees*; and hope within 2 or 3 Years, to reap good Silk off them. I have planted them in a way unuſual here, which advances them two or three Years growth, in reſpect of their being ſown in Seed. I intend likewiſe to plant them all, as if they were *Currants* or *Gooſe-berries*, ſo thick as Hedges. By this way of planting them in Hedges they will be always young tender Plants; and conſequently will be eaſily cut in great quantities with a pair of Garden Sciſſars; whereby one Man may gather as many of them, as otherwiſe, when they are planted in Trees at diſtance, 4 Perſons can do. But Perhaps it may be a better way to ſow ſome Acres with *Mulberry*-Seed, and to cut it with a Scythe, and ever to keep it under.

XXXV. The vulgar Huſbandman (without the Expences, Curioſity, Care, or Trouble of grafting) may propagate the *Genet Moyles* by the knotted Branches alone, in Ground that deſerves not to be called fertile; as they do in the Rye-Land, and Gorſty Ground in *Wales*: And the Cyder made of the Fruit, which, when perfectly ripe, hath a peculiar Fragrancy, is delicately agreeable to tender Palates, till the heat of *July* does too often alter the Caſe.

Choice of Fruit-Trees for ſpeedy Propagation and pleaſant Liquor; By Dr. J. Beal, n. 71. p. 2146.

There is a Summer Apple called *French Cornel*, early ripe, and very richly full of a moſt pleaſing Liquor, which I dare extol for a moſt delicious Beveridge before the ordinary time for Cyder comes in. 'Tis a ſmall Tree, all the Branches criſped, and curled full of Knots at every turning, and apt to grow by any Branch that is cut off below the Knot. It proſpers beſt in a good Mould better than that of the common Field; yet in the dry Rye-land it bears plentifully every ſecond Year, and when one of theſe Trees falls, the next of the ſame Kind may have a full Burden.

Some Soil which doth hardly bear Apples, does moſt kindly bear Pears; and there is a great Variety of Pears to humour every Palate. In the Confines between *Worceſter* and *Hereford*, from *Powick* to *Boſbury*, the *Bare-land-Pear* grows in the common arable Field. That, and ſome other Pears of uncertain Names, in *Powick* do yield a very ſtrong and long laſting Liquor. The *Horſe Pears*, as there they call them, the white and red of ſeveral Kinds yield abundance of pleaſant Liquor. The *Ailets*, great and little, wild and gentle, the *Linton-Pear*, *Lullam-Pear*, *Squaſh-Pear*, have their peculiar Excellencies for Liquor, and ſome of them for the largeneſs of the Tree; yielding conſtantly ſome Hogſheads of Liquor every Year.

Where the Soil hath been tried and found kindeſt for Apples, it is the ſureſt Way to plant Pears alternatively; and where the Liquor of Pears is weak, or leſs laſting, this may be helped by a gentle Mixture of Crabs, or of the harſheſt Apples, to humour all Palates, and for a help to the Stomach, the Mixture being made in the time of grinding the Fruit together. And thus, when the better Soil is too ſhallow for Apples, but receives Pears kindly at a greater depth, a Hedge-row of Crabs, or wild auſtere Apples, raiſed on the Mounds, and ripening in the ſame Seaſon, will by well ordering it, afford ſuch a perfect Remedy, that judicious Palates may be deceived, and take it for the beſt *Cyder*, Sir *W. S.* recommends the *Hamlin-Apple* of *Devon* for *Cyder* equal to the beſt, if not excelling.

An eaſy way of raiſing Fruit-Trees, by Mr. Lewis, *n.* 95. *p.* 6067.

XXXVI. Take a piece of the Root of an Apple-tree or Pear-tree, *&c.* about ſix Inches long, and Tongue-graft a Graft of an Apple or Pear into the Root. The Way of Tongue-grafting, is, to cut the Root ſloping about one Inch, and the Graft ſloping in like manner one Inch; cutting both very ſmooth: Then cleave the Root and the Graft likewiſe about one Inch, and enter them into one another, that the Sap of the Graft may join to the Sap of the Root, as much as you can. Lap the jointed Place about with a little Hemp or Flax-hurds; ſet the Root ſo grafted into the Ground about ten or twelve Inches deep, ſo as the Joint may be covered at leaſt four Inches under the Earth, that it may not be bared at any time, but kept moiſt by the Earth.

The Root you graft upon, muſt not be leſs than your Graft; it is no Inconvenience if it is bigger: But it is the beſt that the Root and the Graft be of the ſame bigneſs.

About 29 Years ſince I ſowed a Bed of Apple-Kernels in *March*, the Spring following I plucked up 40 of thoſe Seedlings, grown to the thickneſs of a fair Graft; I grafted them in this manner of Tongue-grafting, and planted them again. They all grew, and 4 of them bore Fruit to Perfection that Year; ſo that in a Year and half, from an Apple-Kernel I had ripe Fruit. Some of theſe Trees will now bear two Quarters of Apples upon a Tree; and are bigger than moſt of thoſe Trees among which they ſtand, which coſt 12 *d.* the Tree when theſe were Kernels.

I conceive that Plumbs, Cherries, Apricocks, Peaches, and all ſorts of Fruit-Trees may be thus raiſed.

The beſt Seaſon of tranſplanting, by Mr. R. Reed, *n.* 70. *p.* 130.

XXXVII. 1. I never begin to plant till *Valentine*'s Day; and I approve of late Planting before early; the Cold in the Winter kills more than the Drought in Snmmer. We impute it indeed to the Drought, becauſe they languiſh until Summer, and then die: But they receive the fatal Stroke by the Cold in Winter.

For either we take our Stocks out of Woods or out of Nurſeries; in either Place they lie warm, and if you tranſplant them in *October*, you expoſe them on a ſudden to an open Air, and adventure them, being weak, to a long and perhaps cold Winter, which they cannot bear. Add hereunto, that I can relieve them againſt the Drought, by watering and covering the Ground, to keep it cool: But there is no Fence againſt the Froſt, which many times gets into the Roots, and kills, ſo that they never ſpring; or if they do, yet purlingly, and die in the Spring; or if they ſurvive, as many do, yet come on very ſlowly and pitifully. For the Bark does cleave to the Wood by reaſon of the Cold, which dries and clings them together, that, like a Hide-bound Horſe, they will not admit the Sap which the Root would ſend up; and other Suckers grow out of the Earth; and the Trees grow dry, and turn red: All which diſcovers the Obſtruction in the receiving the Sap, which would come from the Root, and then we are forced to ſcore and looſen the

Bark, as we can. Now on the other ſide, if the Summer proves moiſt, the Danger and Fear of late Setting is over, and they will thrive and come forward amain; if otherwiſe, I ſeldom ſee but they always keep green and freſh, being maintained in Life and Verdure by the Sap they receive in the beginning of the Spring, before they be tranſplanted.

This therefore I do (which I ſubmit to better Judgments and Experience;) In the dead of Winter, I prune and cut the Tree I intend to tranſplant, as I would have it be, to the end to loſe nothing of its Strength when I tranſplant. Then I ſuffer it to abide untouched by the Spade till *Valentine*'s Day, and then remove it after it hath taken in ſomewhat of the Spring. I am very careful to preſerve and ſet the Roots as large as I may; ſuppoſing the larger Root, the more Strength and Sap it contains, and ſo will advance the more the growth of the Tree; ſince every thing grows in Proportion to the Root beneath. But I have heard from ſome Planters, who had Experience therein, that Roots cut ſhort do beſt, as ſending forth new Roots, which draw Sap and Nouriſhment beſt. And we ſee that *Moyles* ſet on Slips, that have no Roots, come to a Tree ſooneſt; and I have oft obſerved, that a *Moyle* tranſplanted after it hath taken Root, does not live ſo certainly, or thrive ſo well, as a Slip newly ſet.

2. Dr. *Lauremberg*, a Perſon of much Experience, agreeth with Mr. *Reed*, that Plants which cannot well bear the hardſhip of the Winter, ſhould be tranſplanted in the Spring: but that ſuch as are able to bear the Extremity of a cold Winter, ſhould be tranſplanted in Autumn. In this he only differs that he ſaith, *Poma, Pyra, Ceraſa vulgaria, Coryli, Oxyacanthi, Prunâ, &c. facile frigus ferunt, & Autumno tranſplantari optimo ſucceſſu ſolent*; and then for the Spring, he refers *Juglandes, Perſica, Abricoca, aliquot Ceraſorum genus.* And I think, where he wrote and practiſed, it is as cold a Country as *England.* I ſhall only add, that it is an old *Engliſh* and *Welſh* Proverb, concerning Apples, Pears, and the Hawthorn Quick, Oaks, &c. *Set them at* Allhallontide, *and command them to proſper; ſet them after* Candlemas, *and intreat them to grow.*

By Dr. J. Beal, *n.* 71. *p.* 2148.

Laurenb. de Hort. Cult. l. 1. c. 28.

XXXVIII. It is to be noted, That the Bloſſoms of Fruit-Trees do not forthwith diſcover the Blaſt; for an old experienced Countryman having once given me notice of a blaſty Noon (it being then ſultry Weather and ſomewhat gloomy with the Thickneſs of Exhalations, almoſt like a very thick Miſt) within a Day or two after ſhewed the Proof upon the Cherry-Bloſſoms, then flagging, but not much altering their Colour till two Days more were paſt.

Bloſſoms do not forth-with diſcover a Blaſt; by Dr. Beal, *n.*23. *p.*424.

XXXIX. 1. I do commend for the advancing of *Cyder* in Richneſs, both for Taſte and Colour, a new Caſk, provided it be made of Timber very well ſeaſoned; otherwiſe it may ſpoil it utterly. I have often tried it, and found that ſort of Caſk to improve the *Cyder.*

Cyder, by Mr. R. Reed, *n.*70. *p.*2128.

The beſt *Cyder* I ever had, was Redſtreak grafted upon a *Gennet Moyle*-ſtock. For, as thoſe Kinds do beſt agree, and the Trees ſo grafted ſeldom canker (as do the old Redſtreak upon a *Crab*-ſtock) ſo the Fruit is far more ingenious and milder; and being ripe, both rich and large, and good to eat; and the *Cyder* is more ſmooth, and abates in Strength and Harſhneſs of that on the *Crab*; and needs leſs of mellowing before making; the Stock in Degree altering and reclaiming the Nature of the Fruit. For, as an Apple doth beſt grafted on a *Crab*, which gives Acrimony and Quickneſs to the Fruit, ſo a Crab (and a Redſtreak is no other) grafted on an Apple, receiveth thence Gentleneſs and Softneſs, and Largeneſs, and an excellent Alloy to the Sharpneſs, and (as Mr. *Evelin* calls it) the Wickedneſs of the Fruit.

An excellent Drink from Apples and Mulberries, by Mr. Sam. Colpreſs, *n.* 27. *p.* 501.

2. A Compoſition of the Juices of good Cyder-Apples and Mulberries produceth the beſt taſted and moſt curiouſly coloured Liquor, that many ever ſaw or taſted.

Vines, by Mr. J. Templer, *n.*93. *p.*6016.

XL. I have lately ſeen a pretty and pleaſant Culture of Vines, at the Houſe of a Gentleman, who makes very good *White-Wine* of his own Grapes. He lets Vines aſcend by one ſingle Stem to the Eaves of his Houſe (cutting off all the luxuriant Branches, by the way) then gives them liberty to ſpread upon the Tiles, all over one Side of the Roof of his Houſe. Thus he furniſhes his Dwelling-Houſe, and many Out-Houſes; by which means the Vines are no Hindrance to his other Wall-Fruit, and the Rays of the Sun being almoſt direct upon the Vines, he hath riper, ſweeter and greater Plenty of Grapes, than when their Vines are placed as Wall-Fruit.

To make Muſcadine Wine; *By* M. de Martel, *n.* 58. *p.* 1183.

XLI. At *Frontignac*, they let the Grapes grow half dry upon the Vine, and as ſoon as they are gathered, they tread and preſs them immediately, and turn up the Liquor, without letting it ſtand and work in the Fat, the Lee cauſing its Goodneſs. Thus is made the true genuine *Muſcadine*, without mixing any other Sort of Grapes with it. Lately a certain Perſon thought fit to paſs White-Wine of another Kind upon the Huſks (which are wont to be caſt away) of the *Muſcadine* Grapes: And hath made in this Manner an excellent Wine, which hath the Taſte of *Muſcadine*, and is more pleaſing to ſome, nor is ſo heady, as the franc or true *Muſcadine*.

The Way of making Vinegar *in* France: *By* M. . . *n.* 61. *p.* 2002.

XLII. They take two great Caſks, within each of which they put at the bottom a Trevet, which muſt be one Foot high, and as large as the Largeneſs of the Caſk permits. Upon this Trevet they put Vine-Twigs; whereon they lay a Subſtance called Rape, with which they fill both Veſſels, within half a Foot from the Top. This Rape is nothing elſe but the Wood or Stalks of the Cluſters of Grapes dried and freed from the Grapes. The Trevet and the Vine-Branches are put at the Bottom of the Caſks, only to keep the Rape from the Settling at bottom. It is this Rape which alone heats and ſours the Wine. The two Veſſels being almoſt quite filled with the Rape, one of them is filled up with Wine, and the other only half full for the time; and every Day they draw by a Cock half the Wine that is in the full Veſſel, therewith quite to fill up the other that is but half full; obſerving interchangeable Turns of filling and unfilling the Veſſels. Ordinarily, at the end of 2 or 3 Days, the half-filled Veſſel begins to heat, and this Heat augments for ſeveral Days ſucceſſively, continuing to do ſo till the *Vinegar* is perfectly made; and the Workmen know, that the *Vinegar* is made by the ceaſing of the Heat. In Summer it is a Work of 15 Days: In Winter it proceeds more ſlowly; and that according to the Degree of Cold Weather.

When the Weather is hotteſt, the Wine muſt be drawn twice a Day, to put it out of one Veſſel into the other. It is only the half filled Caſk that heats, and as ſoon as you have done filling up, its Heat is choaked and ſtopped for the Time, and the other Caſk, which is unfilled, begins to heat.

The full Veſſel is quite open at the Top; but a wooden Cover is put on the Veſſel that is but half-full.

The beſt Wine makes the beſt *Vinegar*; but yet they make good *Vinegar* of Wine that is turned.

The Wine in changing leaves a certain Greaſe, which ſticks partly to the Sides of the Caſk (and that they take Care to do clean away) and partly to the Rape; ſo that if they cleanſe not the Rape from it, almoſt every Year once, the Wine turns into a whitiſh Liquor, which is neither Wine nor *Vinegar*.

At the time when they pour the Wine out of one Veſſel into another, Scum ariſeth on the Top of the Veſſel, which muſt be taken carefully away.

In the Caſks, which have never ſerved for this purpoſe before, the Vinegar is made more ſlowly, than in ſuch as have been uſed already.

The Rape, as ſoon as it is ſeparated from the Grapes (which is done immediately after Vintage) is carefully put up in Barrels, leſt it take Air; without which it would heat itſelf and be ſpoiled. *ib. p.* 2034.

There is no other Way of keeping the Rape that hath once ſerved already, than to drown it; that is to ſay, to fill the Veſſel wherein it is with Wine or Vinegar. Rape will ſerve a Year, more or leſs, provided care be taken of cleaning every Morning, with a piece of Linen, the Greaſe that is on the Sides of the Veſſel; and with a little Broom, that which ſwims on the top of the Liquor. The Rape may be freed from its Greaſe with Water, rubbing it between one's Hands. No body that I know hath hitherto examined what this Greaſe is.

I have been lately informed, that there have been Merchants here, who made Vinegar with Phlegm of Wine, remaining after the *Aqua Vitæ* is extracted from it.

XLIII. A Provincial at *Paris* pretends to keep Orange-Trees in that Town all the Winter long without any Fire, tho' they remain in the Earth, and not be put in Caſes or Boxes. This is thought to be effected by a peculiar ſort of Dung uſed for that Purpoſe, and wrought deep into the Ground. *Orange Trees; By* . *n.* 29. *p.* 554.

XLIV. We have Orange-Trees at *Florence* that bear a Fruit which is Citron on one Side, and Orange on the other. They have not been brought hither out of other Countries, and they are now much propagated by Engrafting. *One individual Fruit half Orange and half Lemon*; n. 29. p. 453. *By Mr.* . ib.

2.

2. A very ingenious *Engliſh* Gentleman aſſerts that himſelf not only had ſeen but bought of them *An.* 1660, in *Paris*, whither they had been ſent by *Genoa* Merchants; and that on ſome Trees he had found an Orange on one Branch, and a Lemon on another Branch, as alſo (conſonant to the *Florentine* Information) one and the ſame Fruit half Orange and half Lemon; and ſometimes three quarters of one kind, and one of the other.

By Pet. Natus, *n.* 144. *p.* 313.

3. About thirty Years ſince a Tree was firſt met with in a Grove near *Florence* having an Orange Stock, which it ſeems was ſo grafted upon, that thence it became in its Branches, Leaves, Flowers and Fruit, three-formed; ſome emulating Orange, ſome Lemons or Citron, ſome partaking of both Forms in one. And particularly as to the Fruit, ſome of this Tree are mere Oranges, yet ſome of them of an oblong Shape like Lemons, ſome round like common Oranges, ſome between both: Others taſte like genuine Oranges, others have an Orange Shell, but a Lemon Pulp. Moſt are of a very ſtrong Scent, and a Shell of a very bitter Taſte. But then the ſame Tree bears alſo a kind of a Citron-Lemon, yet not ſo many as of the former kind. And not only ſo, but it produces alſo a Fruit, that is in one both Lemon, Citron and Orange; ſo as you may ſee outwardly two ſorts of Fruit repreſented in one Piece; one, Citron-Lemon, the other Orange. But this Fruit is ſo diverſified, that ſome of them are half Citron-Lemon, half Orange; others have two thirds of Citron-Lemon and one of Orange, others the contrary: And of all theſe, ſome are oblong, ſome round, ſome bunchy, ſome ſmooth, ſome rugged, ſome ſmall, ſome of the bigneſs of two Pound Weight. Their Fleſh is ſo diſtinguiſhed, that where the Orange Pulp ends, that of Lemon begins; and on the contrary. Again, the Orange Pulp is narrower than that of Lemon; but this is tenderer than that, not ſo agreeable to the Taſte, as the genuine ſingle Fruit. They have either none, or very few, or empty Seeds: Nature, it ſeems, ſince this Tree is of the Inſititious Kind, nor can be repaired or propagated by Seed, is not at all ſollicitous in the Generation of them.

The firſt Original of this Tree was by inoculating Orange upon a Citron-Lemon-Stock, ſo that by the Marriage of theſe Trees, repeated for many Years, it was come to paſs, that by the cloſeneſs of the Inoculation, whereby in length of time the mixed Nature of both Trees was grown together, which the different Juices, permeating the common Fibres, had for a long time nouriſhed, there emerged at length a *Germen* or Graft, perfectly retaining the Nature and Species of both; into whoſe different Branches when ſometimes one, ſometimes both Kinds of Juices did paſs, it produced on one of thoſe Branches a mere Orange, on another a Citron-Lemon, on a third a Citron-Lemon-Orange, and even ſometimes upon one and the ſame Branch, all the three ſorts of this Fruit together.

An Account of the Coffee-Shrub; By Dr. H. Sloan, *n.* 208. *p.* 63.

XLV. Mr. *Edw. Clyve* (and he is the firſt) who brought a dried Branch of the *Coffee-Shrub* A. A. from *Mecha* in *Arabia Felix*, gives this Account of it. This Branch was taken off a Tree 7 or 8 Foot high, is about 5 Foot long and covered with a grey almoſt ſmooth Bark. The Wood is white, and the

Pith not very large, the Twigs are covered with a dark-coloured very ſmooth Bark, and riſe oppoſite to one another by Pairs, ſtanding croſs to one another, coming out of oppoſite Sides of the Branch, or the two Pairs next to one another, cutting each other at Right Angles. After the ſame manner ſtand the Leaves on the Twigs, as the Twigs on the Branches, at ſometimes an Inch, and ſometimes two Inches diſtance, each Pair of Leaves from the other one. The Leaves have ¼ Inch Foot-Stalks, being about four Inches long, and two broad in the Middle where broadeſt; whence they decreaſe to both Extremes, ending in a Point. They are ſmooth, whole, and without any Inciſures on their Edges, ſomewhat like the Leaves on a Bay. The Fruit comes *ex Alis Foliorum*, hanging or ſticking to the Twig by ⅓ Inch long Strings or Foot-Stalks; and ſometimes one, two or more, at the ſame Place.

Fig. 165.

Theſe *Shrubs* are planted in *Arabia Felix*, called *Jaman*, every where in a rich Ground or Mould, in great Plenty, and are watered in times of Drought as other cultivated Vegetables there, by artificial Channels from Rivers cut on purpoſe to nouriſh them; and after three, four or more Years bearing, the Inhabitants are forced to plant new *Shrubs*, becauſe the old ones become not ſo fruitful after that time. They dry them in the Sun, and afterwards take off the outward Huſk of the Berries by means of Hand-Mills, as they do here the Huſks of ſeveral ſorts of Grain, to fit them for Uſe: And the *Arabians*, in Summer Heats, uſe theſe Huſks, roaſted after the manner of Coffee-Berries, eſteeming the Drink more cooling, it being ſouriſh to the Taſte.

Explication of the Figures.

A. A. Repreſents the *Shrub*, wherein is obſervable the manner of its Branching, and of the growing of the Leaves and Fruit.

a a a a. The Fruit, growing two, three, or more at a Place on the Twigs.

B. One of the Leaves, of its natural bigneſs.

C. The Fruit, of the true Size and Figure.

c. The Fruit, with the Huſk on.

e. The Fruit, with the outward Huſk taken off.

i. i. The Berry, with both Huſks taken off.

An Account of Coffee; By Mr. J. Houghton, n. 256. p. 311.

XLVI. I cannot learn the Uſe of any part of the *Coffee-Shrub* except the Berries; of which, boiled in Water, a Drink is made, and drank much among the *Arabians* and *Turks*. Perhaps it was their *Succedaneum* for Wine, which *Mahomet* had prohibited: For by its actual Heat it refreſhes the Weary, and does ſeveral other Services, as Wine that acts by a potential Heat.

It has not been in Uſe (as Mr. *Tavernier* tells us) much above 120 Years. However the Uſe of it quickly became general, and that made it a Trade in great Towns. Into the publick Coffee-Houſes they would come by Hundreds, and among them Strangers would venture, where they learned the Cuſtom, and carried it into their own Countries. One Mr. *Raſtal*, an *Engliſh* Merchant, whom I knew, found a Coffe-Houſe at *Leghorn* in 1651. The next Year Mr. *Daniel Edwards*, a Merchant from *Smyrna*, brought into *England* a *Greek* Servant called *Paſqua*, to make his Coffee: So that it is likely that this Merchant was the firſt who uſed it in *England*, (though I am informed that the famous Dr. *Harvey* did frequently uſe it) as his Servant *Paſqua*, whom he thought fit to ſet up, was the firſt Coffee-Man.

The beſt Coffee-Berry is what is large and plump, with a greeniſh Caſt, and having on the thin Parts a Tranſparency; the other has a yellowiſh Caſt, and is more opaque; but when they are roaſted, it is hard to diſtinguiſh.

I put ſome Berries into a Glaſs of Water about a Week ſince, to ſee if they will ſprout; but as yet there is no appearance, although they are tolerably ſwelled, and look white and bright.

I have made a Decoction of them, which has made them ſhoot.

The common Way of preparing the Berry for the Drink-Coffee, is roaſting it in a Tin Cylindrical Box full of Holes, through the Middle of which runs a Spit; under this a Semicircular Hearth, wherein is made a large Charcoal Fire: By the help of a Jack, the Spit turns ſwift, and ſo it roaſts, being now and then taken up to be ſhaken. When the Oil ariſes, and it is grown of a dark-brown Colour, it is emptied into two Receivers, made with large Hoops, whoſe Bottoms are Iron Plates, theſe ſhut into: and there the Coffee is well ſhaken, and left till almoſt cold, and if it looks bright, oily, and ſhining, it is a ſign it is well done.

Of this, when freſh, if an Ounce be ground, and boiled in ſomething more than a Quart of Water, till it be fully impregnated with the fine Particles of the Coffee, and the reſt is grown ſo ponderous, that it will ſubſide, and leave the Liquor clear and of a reddiſh Colour, it will make about a Quart of very good Coffee.

The beſt way of keeping the Berries when roaſted, is in ſome warm Place, where it may not be ſuffered to imbibe any Moiſture, which will pall it, and take off its Briſkneſs of Taſte. 'Tis beſt to grind it as uſed; except it be ramm'd into a Tin-pot, well covered and kept dry, and then I believe it will keep good a Month.

There will ſwim upon the Coffee an Oil, which the *Turkiſh* great Coffee-Drinkers will take in great Plenty, if they can get it. When the Coffee has ſtood ſome time to cool, the groſs Parts will ſubſide, the Briſkneſs will be gone, and it will grow flat, and almoſt clear again.

I ſent to the Chymiſt 1 Pound of clean Coffee, 1 Pound of huſked Horſe-Beans, and 1 Pound of picked Wheat; and I received back,

	Coffee.			*Horſe-beans.*				*Wheat.*		
	℥	ʒ	℈	℥	ʒ	℈	gr.	℥	ʒ	℈
Spirit net.	VI.	VI.	o	VI.	I.	o	XII.	VIIII.	II.	I.
Oil	II.	IV.	II.	I.	III.	o	X.	I.	o	gr. VI.
Cap. Mort.	V.	III.	o	V.	III.	o	o	IV.	VI.	

By this Account it appears, that *Coffee* yields by Diſtillation in a Retort almoſt double as much Oil as *Beans*, and almoſt treble as much as Wheat.

The

Plate. 8. Vol. 2. Pag. 664.

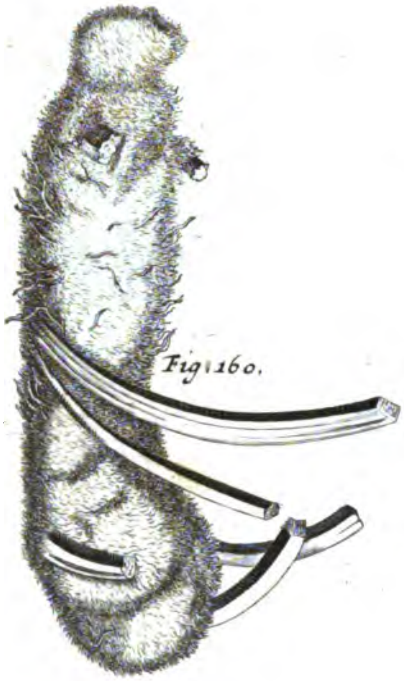
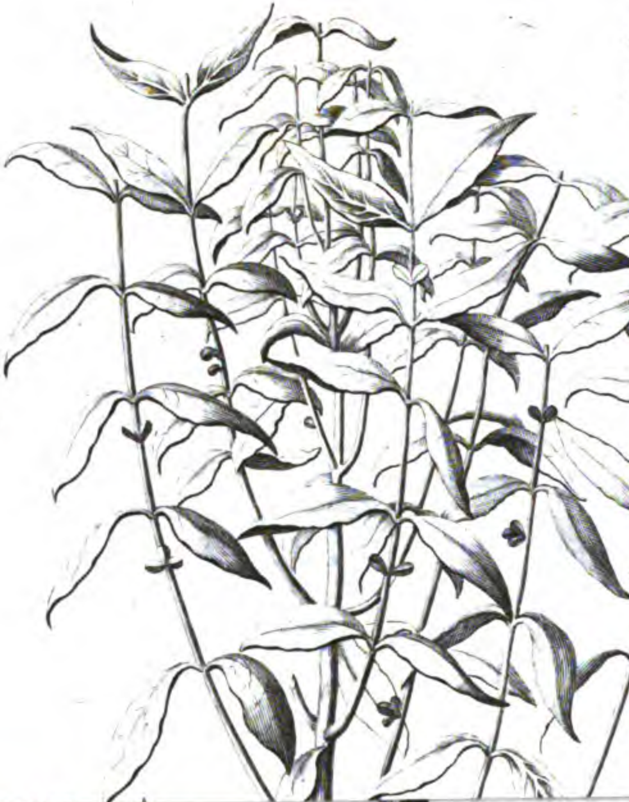


Fig. 160.



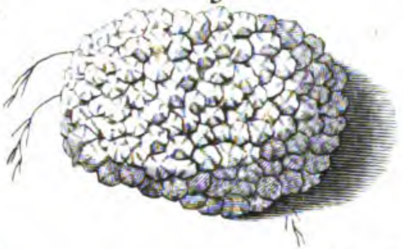


Fig. 157.

Fig. 161.

Fig. 163.

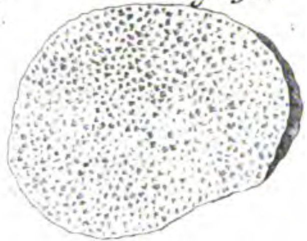


Fig. 158.

The Oils are very thick, but they and the Spirits have all of them ill Savours, as is uſual from burnt Materials.

By Spirit is meant the Phlegm.

The *Capita mortua* have no Smell. They have been calcined over and over, with all the Art my Chymiſt has; but he cannot reduce them to a Calx or Aſhes, and concludes there is no Salt to be gotten from them.

From what is ſaid, I note, that from the common Drink called Coffee, there is little good [illegible]ne from any part but its Oil, becauſe its other thin Parts are evaporated, and its thick ſubſides; but its Oil I ſuppoſe to be nutritive *quaſi* an Oil, and warm *quaſi* a Chymical Oil, for all the warm parts are brought hither as to a Point, and thereby it may enliven and invigorate ſome heavy Parts in the fermentative Juices, and nouriſh weak Parts within, as other Chymical Oils do the Parts external when rubbed, but being dilated, as it uſually is, I queſtion whether it does any more good than hot Tea, hot Broth, or any thing elſe that is actually hot; for I believe that actual and potential Heats are much of the ſame Operation.

It has been generally thought to be an *Anti-hypnotick*, or hinderer of Sleep, which I dare not gainſay, Dr. *Willis* and other learned Men having declared it ſo; but now it is come into frequent Uſe, the contrary is often obſerved, although perhaps Cuſtom, as it does with Opium, alters its natural Qualities.

I am told, that our three Kingdoms ſpend about 100 Tun a Year, whereof *England* ſpends about 70 Tun; which at 14 Pounds a Tun, (a middle Price now a-days) will amount to 20586 *l. Sterling:* and if it were to be all ſold in Coffee-houſes, it would reach treble, or 61740 Pounds, which at 10 Pounds a Head, will find Employment for 9174 Perſons, although I believe all the People of *England*, one with another, do not ſpend 5 Pounds each.

Coffee, when roaſted, loſes about a 4th part, then there is ſpent about 52 Tun and a half of roaſted Coffee, which makes 117600 Pound, or 15252800 Drams, which, if there be 8 Millions of People, is not 2 Drams, or half a Pint of Coffee a-piece for a Year.

Beſides what we uſe, we ſend a great deal abroad, and I doubt not, but in ſhort time, the Gain of what we ſend abroad, will pay the firſt Coſt of all we ſhall ſpend at home; which is one of the beſt ways to make advantage of foreign Trade.

The Cacao-Tree, n. 93. p. 6007.

XLVII. The Body of a *Cacao-Tree* is commonly about 4 Inches in Diameter, 5 Foot in height, and above 12 from the Ground to the top of the Tree. Theſe Trees are exceedingly different amongſt themſelves; for ſome ſhoot up in 2 or 3 Bodies, others in one. Their Leaves are many of them dead, and moſt diſcoloured, unleſs on very young Trees. We reckon a bearing Tree yields from 2 to 8 Pound of Nuts a Year; and each Cod contains from 20 to 30 Nuts.

The manner of curing them is, to cut them down when they are ripe, and to lay them to ſweat 3 or 4 Days in the Cods, which is done by laying them on Heaps. After this, they cut the Cods and take out the Nuts, and put them into a Trough covered with Plantain-Leaves, where they ſweat again about 16 or 20 Days. The Nuts that are in each Cod are knit together by certain Fibres, and have about them a white kind of Pulp, that is agreeable to the Palate. By the turning and ſweating, their little Strings are broken, and the Pulp is imbibed and mingled with the Subſtance of the Nut. After this, they are put to dry 3 or 4 Weeks in the Sun, and then they become of a reddiſh dark Colour.

The Cods grow only out of the Body, or great Limbs and Boughs, and at the ſame Place there are Bloſſoms, and young and ripe Fruit.

The greateſt Crop at moſt of our *Cacao* Walks in *Jamaica*, is in *December* or *January:* But at one of Col. *Muddiford's* Walks, they bear moſt in *May*; yet it is not above 5 Miles from thoſe Walks, which bear always in *December:* But thoſe that bear then, have ſome Fruit in *May*, as the other have in *December*.

It is planted firſt in the Nut, always under ſhade. Some do it under Caſſave; others, under Plantain-Trees, and ſome in the Woods. The *Spaniards* uſe a certain large ſhady Plant, called by them *Madre di Cacao*, we only the others. It muſt alſo be always ſheltred from the *North-Eaſt* Winds. We ſeldom tranſplant, only where it fails, as it doth many times in open, poor, and dry Lands; for this Tree requires to have a flat, moiſt, low Soil, which makes them to be planted commonly by Rivers, and between Mountains; ſo that it is ill living where there are good Cacao-Walks. In a Year's time the Plant comes to be 4 Foot high, and hath a Leaf ſix times as big as an old Tree, which, as the Plant grows bigger, falls off, and leſſer comes in their Place.

The Trees are commonly planted at 12 Foot diſtance, and at three Years old, where the Ground is good, and the Plant proſperous, it begins to bear a little; and then they cut down all, or ſome of the Shade; and ſo the Fruit increaſes till the 10th or 12th Year; then the Tree is ſuppoſed to be in its Prime. How long it may continue ſo, none with us can gueſs; but it is certain, the Root generally ſhoots out Suckers, that ſupply the Place of the old Stock when dead or cut down, unleſs when any ill Quality of the Ground or Air kills both.

Cacao was originally of theſe *Indies*, and wild; towards *Maracajo* are divers Spots of it in the Mountains; and I am informed the *Portugueze* have lately diſcovered whole Woods of it up the River *Maranon*.

The *Cacao* paſſes by Detail for Money in *New-Spain*, and the Silver Countries.

The Jamaica Pepper-tree; *by Dr.* H. Sloan, *n.* 192. *p.* 462. *Fig.* 166.

XLVIII. The *Myrtus Arborea, Foliis Laurinis aromatica, Piementa*, or *Jamaica Pepper-Tree*, has a Trunk as thick as one's Thigh, riſing ſtraight about 30 Feet high, covered with an extremely polite or ſmooth Skin, of a grey Colour, and branched out on every Hand, having the Ends of its Twigs ſet with Leaves of ſeveral Sizes; the largeſt being 4 or 5 Inches long, and 2 or 3 broad in the Middle where broadeſt, and when it decreaſes to both Extremes, ending in a Point, ſmooth, thin, ſhining, without any Inciſures, of a deep green Colour, and ſtanding on ſuch long Foot-Stalks, when bruiſed very odoriferous, and in all things like the Leaves of a Bay-Tree. The Ends of the Twigs are branched into Bunches of Flowers, each Foot-Stalk ſuſtaining a Flower made up of four herbaceous or pale green *Petala*, bowed back, or reflected downwards, within which are many *Stamina* of the ſame Colour. To theſe follow a Bunch of crowned or umbilicated Berries (the Crown being made up of four *Foliola* or ſmall Leaves) which are bigger when ripe than Juniper-Berries, at firſt when ſmall, greeniſh; but when ripe, they are black, ſmooth and ſhining; containing in a moiſt, green, aromatick and biting Pulp, two large *Acini*, or Seeds, ſeparated by a Membrane lying between them; each whereof is an Hemiſphere, and both joined make a Globe or Spherical (appearing one) *Acinus*, whence *Cluſius* makes it one Seed diviſible into two Parts.

It grows on all the hilly Parts of the Iſland of *Jamaica*, but chiefly in the North-ſide thereof: And wherever theſe Trees grow, they are generally left ſtanding when other Trees are felled, and they are ſometimes planted where they never grew, becauſe of the great Profit from the cured Fruit, ſent in great Quantities yearly into *Europe*.

It flowers in *June*, *July*, *Auguſt*, but in ſeveral Places ſooner or later, according to their ſituation and different Seaſon for Rains; and after it flowers, the Fruit ſoon ripens; but it is to be obſerved, that in cleared open Grounds, it is ſooner ripe than in thick Woods.

There is no great Difficulty in the curing, or preſerving of this Fruit for Uſe; it is for the moſt part done by Negroes, they climb the Trees, and pull off the Twigs with the unripe green Fruit, and afterwards carefully ſeparate the Fruit from the Twigs, Leaves, and ripe Berries. Which done, they expoſe them to the Sun, from its riſing to ſetting, for many Days, ſpreading them thin on Clothes, turning them now and then, and carefully avoiding the Dews, which are there very great. By this means they become a little wrinkled, or rugous dry, and from a green change to a brown Colour, and then they are fit for the Market, being of different Sizes, but generally of the bigneſs of Black-pepper, ſomething like in Smell and Taſte to Cloves, Juniper Berries, Cinnamon and Pepper, or rather having a peculiar mixed Smell, ſomewhat akin to them all: Whence the Name of All-ſpice. The ripe Berries are very carefully ſeparated ftom thoſe to be cured, becauſe their wet and plenteous Pulp renders them unfit for Cure. Whence theſe Berries always coming unripe dried into *Europe*, has been the Occaſion of the Naturaliſts thinking it to be *Fructu umbilicato ſicco*. The more fragrant and ſmaller they are, they are counted the better.

This Fruit with Water diſtilled *per Veſicam*, yields a very odoriferous Chymical Oil, ſinking to the Bottom of Water like Oil of Cloves. It may deſervedly be counted the beſt and moſt temperate, mild, and innocent of common Spices; and fit to come into greater Uſe, and to gain more Ground than yet it hath, of the *Eaſt-India* Commodities of this Kind; almoſt all of which it far ſurpaſſes, by promoting the Digeſtion of Meat, attenuating tough Humours, moderately heating, ſtrengthning the Stomach, expelling Wind, doing thoſe friendly Offices to the Bowels, as we generally expect from Spices.

It is now commonly ſold by Druggiſts for *Carpobalſamum*, which I ſuppoſe came from *Hernandez*, who ſays it may be its *Succedaneum*; but it is not that Fruit, but ſeems more fragrant and leſs aſtringent and balſamick. *Cluſius* ſays, that it takes away, if chewed, a ſtinking Breath: *John de Barrius* tells us, it is one of the Ingredients in Chocolate in *New-Spain*: And *Franciſcus Vria*, who brought it from *New-Spain* and gave it to *Redi*, ſaid, it was there commended againſt the *Epilepſy* and *Gutta ſerena*, which he in divers Perſons tried but without Succeſs; but he at the ſame time ſays, he thinks it a good Stomachick and Cephalick Medicine, moderately given.

Exper. Nat. p. 132.

It has been taken by *Cluſius* for *Pliny*'s *Cariophyllon*, and by others for *Amomum*; but it is not likely that it was known to the Antients, not being known to grow in the *Eaſt*, but *Weſt-Indies*.

It is very likely that *Hernandez* does deſcribe this under the Name of *Kocoxite ſeu Piper Tavaſci*; his Deſcription agreeing in every thing but the Flower; which no ways agrees to this. And perhaps this is the Tree which *Piſo* deſcribes under the Name of *Anbuiba Miri*.

Cinnamon & Milium, n. 372. p. 1031.

XLIX. M. *de Villermont* has a ſort of *Cinnamon*, which comes from *Guardaloupe*, which is white; and another ſort, which comes from *Maragnan*, which is like that of *Ceilon*.

He has an Ear of the ſmall *Milium* of *Guinea*, about 10 Inches long, made juſt like the great Knob of a Cane; the Grains are no bigger than a Pin's Head, and are very good to eat; the Negroes making their finer Cakes of them.

The wild Cinnamon-Tree, *by Dr.* H. Sloan, n. 192. p. 465.

L. *Arbor baccifera, laurifolia, aromatica Fructu viridi calyculato ramoſo*, or *Wild Cinnamon-Tree*, commonly but falſly called *Cortex Winteranus*, has a Trunk about the Thickneſs of one's Thigh, riſing to about 20 or 30 Foot high, having many Branches and Twigs hanging downwards, making a very comely Top. The Bark conſiſts of two Parts, one outward, and another inward. The outward Bark is as thin as a milled Shilling, of a whitiſh aſh or grey Colour with ſome whiter Spots here and there upon it, and ſeveral ſhallow Furrows of a darker Colour running variouſly through it, making it rough, of an aromatick Taſte. The inward Bark is much thicker than *Cinnamon*, being as thick as a milled Crown Piece; ſmooth, of a whiter Colour than the outward, of a much more biting and aromatick Taſte, ſomething like that of Cloves, and not glutinous like *Cinnamon*, but dry and crumbling between the Teeth. The Leaves come out near the Ends of the Twigs, without any Order, ſtanding on Inch-long Foot-ſtalks; they are each of them 2 Inches long, and 1 Inch broad, near the End where broadiſh and roundiſh, being narrow at the Beginning, from whence it augments in breadth to near its End, of a yellowiſh green Colour, ſhining and ſmooth, without any Inciſures about its Edges, and ſomewhat reſembling the Leaves of Bay, or *Lauroceraſus*. The Ends of the Twigs are branched into Bunches of Flowers, ſtanding ſomething like Umbels, each of which has a Foot-Stalk, on the Top of which is a Calix, made up of ſome *Foliola*, in which ſtands five ſcarlet or purple *Petala*, within which is a large *Stylus*. To theſe follow ſo many caliculated Berries, of the bigneſs of a large Pea, roundiſh, green, and containing within a mucilaginous pale-green thin Pulp, four black ſhining Seeds, or *Acini*, of an irregular Figure.

All the Parts of the Tree when freſh are very hot, aromatick and biting to the Taſte, ſomething like Cloves, which is ſo troubleſome, as ſometimes to need a Remedy from fair Water.

It grows in the Low-Land, or *Savanna* Woods, very frequently on each Side of the Road between *Paſſage Fort* and the Town of St. *Jago de la Vega* in *Jamaica*, in *Antegoa*, and other the *Caribbee* Iſlands.

The Bark of this Tree is what is chiefly in Uſe, both in the Plantations of the *Engliſh* between the *Tropicks* in the *Weſt-Indies*, and in *Europe*; and is without any Difficulty cured, by only cutting off the Bark, and letting it dry in the Shade.

It is in Uſe in the *Weſt-Indies*, by the more ordinary ſort of People, in place of all other Spices, being thought very good to conſume the immoderate Humidities of the Stomach, help Digeſtion, expel Wind, *&c.*

It is likewiſe, as well there as in *Europe*, thought a very good Remedy againſt the Scurvy, and to cleanſe and envigorate the Blood, being in *London* at Druggiſts and Apothecaries Shops uſed for thoſe Purpoſes, under the Name of *Cortex Winteranus*, which it is not, but may very well ſupply its Place. It is in the *Weſt-Indies* mixed and given with Steel, and other Medicines; but if the Patient be any way of a hot Conſtitution, it does more Harm than Good, being very warm.

Rum, a Vinous Spirit drawn from *Moloſſus*, or bad Sugar fermented with Water, if it be mixed with ſome of this Bark, it loſes in part its loathſome empyreumetick Smell.

This Bark, if mixed with Water, and diſtilled *per Veſicam*, yields an aromatick Oil, ſinking to the Bottom of Water like Oil of Cloves, with ſome ſmall Quantity of which it being mixed, has ſometimes been ſold for true Oil of Cloves. *Peter Martyr* mentions it under the Name of *Cortex Cinnamomi Saporem, Gingiberis Amaritudinem, & Caryophilli ſuavem Odorem præ ſe ferens. Nic. Monardes* deſcribes under the Name of *Lignum Aromaticum: Cluſius* calls it *Lignum, ſeu potius Cortex Aromaticus:* And I queſtion not but this is the ſame with the *White Cinnamon*, or the *Canella Alba*, in ſome other Authors. *Linſchoten* in his Deſcription of *America*, tranſlated into *French*, gives an account of it under the Name of *Arbre, ou les Pigeons nichent:* Dr. *Trapham* calls it *Winter-Bark*, or *Weſt-India Cinnamon-Tree: Hernandez* and *Ximenes*, *Caminga*.

But it may be doubted whether this be the *Aſcopo* of *Hariot*.

The true Cortex Winteranus; *by* *Dr.* H. Sloan, *n.* 204. *p.* 922.

LI. Capt. *Winter*, who went out with Sir *Fr. Drake*, when he went round the World, at his Return brought with him from the Streights of *Magellan* an aromatick Bark, which had been very helpful to thoſe of his Ship, both uſed inſtead of other Spices with their Meat, and as a Medicine very powerful againſt the *Scurvy*. *Cluſius*, from this Captain's Name, calls it *Cortex Winteranus*, and the Tree *Magellanica Aromatica Arbor.* The Writer of the Journal of the *Dutch* Ships that went to the Streights of *Magellan* about 1599, calls it *Lauro ſimilis Arbor, licet procerior, cortice Piperis modo acri & mordenti.* And *Sebald de Weert*, who was there, ſays that both Leaves and Bark were uſed with their Meat and Muſkles to correct them in ſo cold a Climate. *Caſpar Bauhine* calls it *Laurifolia Magellanica Cortice acri: Johnſton, Arbor Laurifolia Magellanica.*

Fig. 168. But Mr. *Geo. Handyſide*, who came from thence about 2 or 3 Years ſince,
gives the beſt account of it; having brought with him a Specimen, or Sam-
Fig. 169. ple of its Leaves and Flowers on the Twig and its Seed; by which I cannot
reduce it to any of our Kind of Plants ſo well as the *Periclymenum*; and there-
fore I ſhall call it, tho' it differs in many things from the *Honyſuckle*, *Periclymenum rectum Foliis laurinis, cortice acri aromatico.*

He aſſured me, that this Tree roſe to be higher and larger than an Apple-Tree, ſpreading very much both in Root and Branches: The Twigs had on them Leaves of a light green Colour on their Upper-ſide, ſtanding on half Inch long Foot-Stalks; are an Inch and half long, and an Inch broad in the Middle, where broadeſt, and whence they decreaſe to both Ends, ending blunt. The Flowers come, *ex alis Foliorum*, ſtanding on ¼ Inch long Stalks; 2 or 3, or more of them together, ſomething like thoſe of the *Periclymenum*, each of them are Milk-white *Pentapetalous*, and ſmell like Jeſſamine; to which ſucceeds an oval Berry, made up of 2 or 3 or more *Acini*, or little Berries, ſtanding together on the ſame common Foot-ſtalk of a light green Colour, with ſome black Spots: And in theſe Berries are contained ſeveral black aromatick Seeds, ſomething like the Stones in Grapes.

It grows in the Middle of the *Streights* of *Magellan* very plentifully.

The Leaves of this Tree were uſed with other Herbs, by Mr. *Handyſide* for Fomentations in ſeveral Caſes, with very good Succeſs; but he admired moſt the Uſe of the Bark inwardly, boiling half a Drachm of it with ſome Carminative Seeds, and giving it ſo to thoſe of the Ship who were under his Care, very much afflicted with the Scurvy. It uſually ſweated them, and they were very much relieved. The ſame Medicine likewiſe he adminiſtred to a great many of the Ship, who were very ill by eating a poiſonous Sort of *Seal* in thoſe Parts, called a *Sea-Lion*; with which they had a very great Amendment, although they had been ſo ill with feeding on this Creature, as to loſe moſt of their Skins, which peeled off their Bodies by degrees, and in large Pieces; ſo that the Antidote to this ſtrange Poiſon was to be had very near it, and was very much extolled by this Gentleman, who was put to a ſtand to know what to do in this ſtrange Caſe, although he very well underſtood the *Materia Medica.*

By the Deſcription of this Tree and that of *wild Cinnamon*, it appears, that the *Cortex Winteranus* commonly ſold in Shops, is not the true *Cortex Winteranus*. But I muſt needs ſay, though they are the Barks of two very differing Trees, and growing in very differing Places, and appear quite another thing in their outward Faces: Yet their Taſte is much the ſame, and I believe they may be uſed as a *Succedaneum*, one for another; though the true be much to be valued beyond the falſe, being much more aromatick.

LII. I have diſcourſed a poor mere *Iriſh* Labourer (who, by having worked many Years under a Head Gardiner, in a Gentleman's Garden, has got a Genius of Planting) who has followed the Propagation of Elms, by the Seed; (a Way if known, totally neglected among all Planters) which Seed he finds in the former part of the Year; and he has raiſed in ſmall Beds ſuch vaſt Numbers of them, that he ſells them of 3 or 4 Foot long, at 2 *s.* a Hundred, and will carry them any where within five Miles, and plant them into the Bargain.

An Account of the Propagation of Elms-ſeed; *by Sir* Rich. Bullkey, *n.* 265. *p.* 971.

LIII. The Savages of *Canada*, in the time that the Sap riſes in the *Maple*, make an Inciſion in the Tree, by which it runs out, and after they have evaporated eight Pounds of the Liquor, there remains one Pound, as ſweet, and as much Sugar, as that which is got out of the Canes; part of the ſame Sugar is ſent to be refined at *Roven*.

A Sort of Sugar from Maple, n. 171. *p.* 988.

The Savages have practiſed this Art, longer than any now living among them can remember.

There is made with this Sugar a very good Syrup of Maiden-hair, and other capillary Plants, which is uſed in *France*.

LIV. Every Part of the *Oak-Tree*, of what Age or Growth ſoever, and all Oaken Coppice Wood of any Age or Size, being cut and procured in Barking-time, will tan all ſorts of Leather, as well at leaſt as Bark alone.

Oak *prepared for Tanning, by Mr.* Ch. Howard *of* Norfolk, *n.* 105. *p.* 93.

This Material being gotten in its proper Seaſon, it muſt be very well dried in the Sun, and more than Bark, then houſed dry, and kept dry for Uſe; and when it is to be uſed, the greater Wood may be ſhaved ſmall, or cleft, and the ſmall bruiſed with a Hammer and cut ſmall; which done, it muſt again be dried very well upon a Kiln, and then ground as Tanners uſually do their Bark.

Such Wood, as it is to be uſed preſently after it is gotten, will require the better and more drying upon a Kiln; otherwiſe it will blacken and ſpoil all the Leather.

Inſtead of an Anvil, to beat and bruiſe the tanning Stuff upon, fit into a wooden Block or Plate of Iron about 4 Inches deep, 9 Inches broad, and 12 Inches long. The Hammer for bruſing the Stuff may be of 6 Pound weight, and have the Head about 3 Inches ſquare, to work with both Hands; but to work with one Hand, or for a Youth to uſe, let it be of about 3 Pound weight, and the Head about 2 Inches ſquare. The Surface of one End of theſe Hammers is beſt to be ſmooth, but that of the other dented, the better to enter into the Stuff for quicker Diſpatch. They are to be well ſteeled at both Ends, the Handles of theſe Hammers may be about a Foot long; the bigger ought to be ſomewhat longer.

The Knife to cut the bruiſed Stuff, may be 8 or 9 Inches broad, and near as much in Depth, made like a Tobacco-Knife, with a Handle to work.

Where *Oak* is ſcarce, Thorns may indifferently well ſupply that Scarcity.

Birch ordered and uſed inſtead of *Oak*, is very fit for Soal-Leather.

As theſe Ingredients will tan better than Bark alone, and that with far leſs Charge, ſo may this Invention ſave the felling of Timber, when the Sap is up; which when it is done, cauſes the outſides of the Trees to rot and grow Worm-eaten; whereas, if the Trees had been felled in Winter, when the Sap was down, they would have been almoſt all Heart, (as they call it) and not ſo ſubject to Worms. Beſides that, this Invention will greatly improve the Value of Underwoods.

A Dwarf Oak from New-England; *By Mr.* F. Willough, *n.* 58. *p.* 1700.

LV. There is no ſuch Dwarf-Oak in *England*, growing wild, as was ſent you out of *New-England*; nor in any other Country where we have been; unleſs it be the *Ilex Coccifera*, which is a low Shrub, having large Acorns, and hath a prickly Leaf like Holly. If it prove that, it will be a lucriferous Diſcovery.

The Way of making Pitch, Tar, Roſin, and Turpentine, By Mr. Tho. Bent, *n.* 243. *p.* 294.

LVI. Five Leagues from *Marſeilles* are very high Mountains, which are (for the moſt part) covered with Foreſts of Pine-Trees, which there grow wild; half a League out of the Road, you ſee the making of Pitch, Tar, Roſin and Turpentine, which is thus, *viz.* in the Spring-time when the Sap runs moſt, they pare off the Bark of the Pine to make the Sap run down into an Hole, which they cut at the bottom to receive it; as it runs, it leaves a Cream or Cruſt behind it, which they take and temper in Water, and ſell, by a Cheat, for white Bees-Wax, that they make Flambeaus of, and is a great deal dearer. Then they take up the Juice in Spoons from the bottom, and after they have ſo gotten a good Quantity, they ſtrain it through a Grocer's Baſket, ſuch as they put their *Malaga* Raiſins in; that which runs through eaſily is the common *Turpentine*. Then they take that which remains above, and adding a ſufficient Quantity of Water, diſtil it in an Alembick; that which is ſo diſtilled is *Oil of Turpentine*, and the *Calx* that remains is common Reſin. Then they cut the Stock of the Tree into large Chips, and pile them hollow in a Cave; covering it on the top with Tiles, but ſo as to let ſome Air come in to feed the Fire; then burning them, there runs a thick Juice down to the bottom, where they make a ſmall Hole for it to run out at, (a larger Hole would ſet it all in a Flame) and that which ſo runs out is Tar. Then they take off that, and boiling it gently over again, to conſume more of the Moiſture, they ſet it to cool; which when cool is Pitch.

A Sort of Miſſeltoe in Jamaica; *By Dr.* Hans Sloan, *n.* 251. *p.* 113.

LVII. In *Jamacia*, the neighbouring Iſles, and Continent of *America*, grow many ſorts of *Miſſeltoe*; paraſitical Plants, as they are called by ſome, or *Epidendra* by others; which grow on the Bodies or Arms of Trees, after the manner of *Miſſeltoe*, like to which they bring forth Roots, Leaves, Stalks, Flowers and Seed. From this likeneſs I have given the Name *Viſcum* to all the ſeveral Families of them; though they differ very much from it, and almoſt as much amongſt themſelves.

Catal. Jam. Plan.

There is one Family among them which I call *Viſcum Cariophyloides*, from having its Seed-Veſſel ſomewhat like that of *Clove-July Flowers*, and a particular one of that Family which I name, *Viſcum Cariophyloides maximum, Flore tripetalo pallide luteo, ſemine filamentoſo*, and which is commonly in

Fig. 170.

that Iſland called *Wild Pine*; whoſe Deſcription follows. A great many brown Fibrils encompaſs the Arms, or take firm hold of the Bark of the Trunk of the Trees whereon they grow. Not as *Miſſeltoe*, entring the

Bark or Wood, to ſuck Nouriſhment, but only weaving and matting themſelves among one another, and thereby making to the Plant a firm and ſtrong Foundation. From hence riſe ſeveral Leaves on every ſide, as *a a a a*, after the manner of Leeks, *Ananas*, whence the Name of Wild-Pine, or Aloes, being folded or incloſed one within another; each of which is two Foot and a half long; from a 3 Inch breadth at Beginning, or Baſe, ending in a Point; having very hollow or concave inward-ſides, is made within a very large Reſervatory, Ciſtern, or Baſin, *b.* fit to contain a pretty deal of Water; which in the rainy Seaſons falls upon the uppermoſt Parts of the ſpreading Leaves, which have Channels in them, conveying it down to the Ciſtern, where it is kept, as in a Bottle; the Leaves, after they are ſwelled out like a Bulbous Root to make the Bottle, bending inwards, or coming again cloſe to the Stalk, by that means hindering the Evaporation of the Water by the heat of the Sun. They are of a light green Colour below, and like Leeks above. From the midſt of theſe riſes a round, ſmooth, ſtrait, freſh Green coloured Stalk, 3 or 4 Foot long, *c.* having many Branches; when wounded, yielding a clear mucilaginous Gum. The Flowers come out here and there on the Branches; they are made up of 3 long yellowiſh, white, or herbaceous *Petala*, and ſome Purple-ended *Stamina*, ſtanding in a long *Calix*, or *Tubulus*, made up of 3 green viſcid Leaves, with purple Edges, to which follows a long triangular *Capſula*, *d.* greeniſh Brown, being ſomewhat like thoſe of the *Cariophylli*; having under it three ſhort capſular Leaves, and within ſeveral long pappous Seeds, the Seed itſelf being oblong, pyramidal, and very ſmall, having very ſoft Hair, Down or *Tomentum*; much longer in proportion to the Seed, than any *Tomentum* I know; being as long as the Pod or *Capſula.*

It grows on the Arms of Trees, every where in the Woods, as alſo on the Barks of their Trunks; eſpecially when they begin to decay, their Barks receiving the Seed, and yielding then more eaſily to the Fibrils of this Plant's Roots, which in ſome time diſſolves them, and ruins the whole Trunk.

The Contrivance of Nature in this Vegetable is very admirable; the Seed has long and many Threads of *Tomentum*, not only that it may be carried every where by the Wind, as the Pappous and Tomentoſe Seeds of *Hieracium*, *Lyſimachia*, &c. are, but alſo, that it may by thoſe Threads, when driven through the Boughs, be held faſt, and ſo ſtick to the Arms and extant Parts of the Barks of the Trees. So ſoon as it ſprouts or germinates, although it be on the under Parts of a Bough, or Trunk of the Tree, its Leaves and Stalk riſe perpendicular, or ſtrait up: Becauſe if it had any other Poſition, the Ciſtern before mentioned (by which it is chiefly nouriſhed, not having any Communication with the Tree) made of the hollow Leaves, could not hold Water, which is neceſſary for the Nouriſhment and Life of the Plant.

In the mountainous as well as dry low Woods, in Scarcity of Water, this Reſervatory is neceſſary, and ſufficient, not only for the Plant itſelf, but likewiſe is very uſeful to Men, Birds, and all ſorts of Inſects; whither in Scarcity of Water they come in Troops, and ſeldom go away without Refreſhment.

There are ſome Contrivances in Plants growing in *Europe*, which come near thoſe of this kind of Vegetables, in ſome Particulars. The *Virga Paſtoris*, or wild Teaſel, (and moſt Plants called Perfoliated) has its Leaves incloſing its Stalk, and ſo ſet by Pairs oppoſite to one another, and joined by their Baſes, that they may make a hollow Place, fit to contain ſome Water, which though open, yet without doubt contributes to the perfecting of the Plant.

Several *Fuci* are lately diſcovered to have Seeds, which, when ripe, break out of their Places, and by means of a glewy Juice faſten themſelves to the Stones, or other Subſtances at the Bottom of the Sea, where they are to grow. The common Viſcum had ſuch a glewy Subſtance, I ſuppoſe, for faſtening its Seed to the Barks of Trees.

Small Moſſes, heretofore thought to have no Seed, are now known to have great Plenty; and that ſo ſmall, as I have ſeen it riſe up from the ripe Head, in form of Smoak; which is without queſtion that it may be carried by the Air and Wind, to Walls, Trees, or other fit *Matrix* for its Vegetation.

There is a *Fundus*, called by *Cluſius*, *Fungus minimus anonymus*; and by Dr. *Merret*, *Campaniformis*, *niger multa ſemina plana in ſe continens*, (which I have ſhewn the *Royal Society* many Years ſince) that when ripe opens in the Rain, by which one filling a Cup, wherein lies its Seeds, they are waſhed out on every hand, to propagate its Kind.

There are many Families of Plants with Pappous, or Tomentoſe Seeds; as *Dandelion's*, *Erigerum's*, *Lyſimachia's*, *Clematis's*, *Anemone's*, &c. which being ripe, their Seeds are by means of their Feathers, or Wings, ſcattered to all neighbouring Parts by the Wind. This is ſo effectual a way, that the *Aſter Canadenſis annuus non deſcriptus*, *Brunyer*, or *Conyza*, *annua alba acris*, *Moriſ.* (which came at firſt from *Canada*) is now become a wild Plant in many Places of *Europe*, where it never was obſerved to grow, and far from the Garden's where it was firſt planted; from whence the Seed had been carried by its Wings; ſo that I have ſeen it in ſome Parts of *France*, very many Leagues from ſuch Places.

Hort. Bleſſ. p. 10.

There are likewiſe many Plants, which have Seed-Veſſels ſo contrived as with a Spring, and ſometimes ſmart Noiſe, when they are ripe, to throw off their Seeds ſeveral ways, to a conſiderable Diſtance. Moſt Plants having Pods, as *Furze*, *&c.* thoſe called, *Noli me Tangere*, or *Herbæ Impatientes*, *Cucumis aſininus*, *Cranes-bill*, and many others, have this Artifice to ſow themſelves. Amongſt thoſe who have this Property, none is more ſurprizing than one in *Jamaica*, called *Spirit-Weed*, which when its Seed is ripe, the Veſſel containing it, on the leaſt Touch of whatever is wet, does inſtantly open itſelf; and with a ſmart Noiſe, throw its Seed ſeveral ways to a conſiderable Diſtance; likely the Deſign of Nature being, that the rainy Seaſon being proper for ſowing, its Seed ſhould be kept in its Seed-Veſſel, the beſt Preſerver of it from Injuries till then.

Lychni's, *Poppies*, *Antirhinnum's*, and many others, have their Seeds in Heads, which, when ripe, are open at top; and by the Winds, and help of their Partitions, are ſcattered and directed to all Quarters.

Theſe Inſtances, and many more, very obvious and wonderful, tho' not taken notice of, might be given to ſhew the great Endeavours of Nature to perfect the *Individuum*, and propagate the kind; which for that reaſon, I am apt to believe, are all (without the loſs of one Species) preſerved to us, from the Creation to this Day.

The Silver Pine *from the* Cape *of* Good Hope; *By Dr.* H. Sloan, *n.* 198. *p.* 664. *Fig.* 171.

LVIII. A Branch of the *Silver-Pine*, or *Conifera Salicis facie, Folio & Fructu, Tomento ſericeo candicante, obductis ſemine pennato*, was lately brought into *England* from the *Cape* of *Good Hope*, by Mr. *Goddard*. The Twig of this Tree had a great many Leaves ſet round it very cloſe to one another, ſo as to hide the Twig it ſelf there where they grow; each of the largeſt of them being about 4 Inches long, and $\frac{3}{4}$ of an Inch broad, in the middle where broadeſt, from whence they decreaſe towards both Extreams, ending in a Point; being like thoſe of the Oſier Willow, only broader, and all covered over with the thickeſt, fineſt and longeſt white Silken Hair or Down, that ever any Plant I remember to have ſeen has. The Cones are of the bigneſs of thoſe of the Cedars of *Lebanon*, and of the ſame ſhape; the *Cuticula*, or ſmall Skin of each Scale, being covered over with a white ſhort Down or Wool; ſhining alſo like Silk; between the Scales is lodged the Seed *C.* which is almoſt as large as the Pine-Nut, near the ſame ſhape, of a dark brown Colour, and having a riſing eminent Line or Belly running thro' a Membrane *D.* which has on its top 4 Feathers, like thoſe belonging to the Seeds of *Clematis*; which being between the Scales, and riſing above them, adds a very great Beauty to the Cone; and may likewiſe ſerve for Wings, by means of the Wind, to looſen or carry the Seeds to diſtant Places, thereby propagating itſelf.

Fig. 172.

Dr. *Plucknet* has figured it under the Name of *Leucadendros Africana, Arbor tota argentea, ſericea Foliis integris; Atlas-Tree, D. Herman.*

Another Coniferous Tree from the Cape of Good Hope; *By Dr.* H. Slcan, *n.* 198. *p.* 666.

LIX. *Conifera, Alypi folio, Seminibus pennatis pluribus in medio Coni conglomeratis, & non inter Squammas, aliorum Conorum more, naſcentibus.*

A Branch of this Tree with its Fruit was lately brought from the *Cape* of *Good Hope*, by Mr. *Goddard*. It had a brown coloured ſmooth Bark with a whitiſh hard Wool, and ſmall Pith. The Leaves (expreſſed to their natural Bigneſs *F.*) were round it without any Order, very thick ſet, having no Foot-Stalks, being about 2 Inches and $\frac{1}{2}$ long, and about $\frac{1}{3}$ of an Inch broad, near the farther end where broadeſt, ſmooth, hard, and of a browniſh or dirty green Colour. On the top of the Branch comes the Fruit, *G.* which is ſurrounded by 3 or 4 Twigs, *H. I. K*, overtopping it, and with their Leaves almoſt hiding it. It is about 5 Inches long, and is made up of many Scales, hard and red, encloſing one another. The lowermoſt and outwardmoſt being very ſhort, the inwardmoſt 4 Inches long, each of them ending in a Point; ſome Scales having on their outſides a gummy Juice. In the middle of theſe Scales were the firſt Rudiments of many Seeds, as *L.* the ſame not being fully ripe; each of which is ſet about with a great Quantity of $\frac{1}{4}$ Inch long, yellow, fine, ſilken Down, *M.* having 2 Inches long *Stylus*, or String *N.*

Fig. 173.

and yellowiſh Membranes O, encloſing the *Stylus* and *Tomentum*, being feathered at top with Feathers, like the Silver Pine, and for the ſame Purpoſes.

Obſervations and Experiments concerning Vegetation, and the running of Sap, by Dr. J. Beal, *and Dr.* Ez. Tonge, *n*. 43. *p*. 853.

LX. 1. There are ſeveral ſorts of Vegetables that will grow the wrong end ſet downwards in the Ground, as Elders, Bryars, Sallies, Willows, the black Elder, Vines, and moſt Shrubs; two or three of their Joints being covered in the Mould, and the Stem cut off near the overmoſt Joint, which ſhould be half covered in the Mould, and the Mould ſomewhat raiſed as it ſpurts out and grows. Dr. *B.* Currant-trees, and ſuch like as are of ſoft Wood, and quick Growers, ſeem moſt apt to this Improvement. Dr. *T.*

2. The Branch of a Plant being laid in the Ground, whilſt yet growing on a Tree, and there taking Root, being cut off whilſt ſo growing, will grow on both Ends, if it be well rooted in the Propagation; and the like care had of the laſt Knot or Joint, as was before preſcribed. Dr. *B.* The Layers of thoſe Trees and Shrubs mentioned in the former Obſervation, will grow on both Ends, and aptly parted when they have ſpread Roots both ways, make two Plants out of each Layer. Dr. *T.*

3. In the tapping of Trees the Juice certainly aſcends from the Root, and after it is concocted to partake of the nature of the Plant, which feeds as well on the Air as the Juice furniſhed thro' the Root, it deſcends (as Liquor in an Alembick) to the Orifice whence it iſſues. *Ratray*, the learned *Scot*, affirms, that he hath calculated experimentally, that the Liquor which may be drawn from the Birch in the Spring-time, is equiponderant to the whole weight of the Tree,Branches, Roots, and all together. And perhaps this kind of large natural Alembick, where it may be had, may ſometimes prove more effectual than our little artificial and more troubleſome Diſtillations. And the Congeniality of the Sun in its alternative Viſits, and the aſſiduous intercourſe of the free Air with the Spirits of the Plant, yet living and growing, may have a more effectual Influence for a ſpecifick Virtue than we are apt to imagine. Tho' we cannot ſee nor hear the Lungs of Vegetables beating, yet we may ſometimes ſmell their Breath ſtrong enough both to pleaſe and offend exceedingly; as in Savin, Firs, Cypreſs, Elder, Roſemary, Myrtles, and generally in all Bloſſomers. And ſome that cannot be ſmelt by us, may yet have a very wholeſome Breath. One Experiment I will here beſtow on you: When both my Hands were manacled for many Years (and ſometimes my Arms alſo) with deep corroding Tetters, to the bluſh of my many friendly Phyſicians, and in deſpite of many of the beſt Medicines and Purgations, all was ſuddenly healed, and has ſo continued theſe 20 Years, by the application of the Gum of Plum-trees diſſolved in Vinegar. I muſt not forget to add, that I applied Vine-leaves, and ſometimes opened Raiſins to draw a moiſture from theſe Tetters, ſome few Days before I uſed the Gum. Dr. *B.*

Dr. *Tonge* is of opinion, that Sap always riſes, and never properly deſcends, having only a kind of ſubſiding or Recidivation, which he ſaith he cannot call a Circulation, nor reſemble to the motion of Liquors in a Pellican, but rather to the ſinking of Liquors in an Alembick, whilſt the thinner Parts are forced over the Helm; yet ſomewhat imitating the Motion of Blood in Animals, foraſmuch as it continually ſupplies the want and expence of Sap in the exterior Parts, from the Stock of the Sap in the Trunk, Root, and Branches.

He underſtands it thus, that the Sap neceſſary to the growth of the Leaves, Fruit and upper Branches, being diſpenſed and converted into the Form neceſſary for theſe Purpoſes, when the Tree is fulleſt of Sap, in ſuch manner that the Sap in the innermoſt Coats feeds the innermoſt, and the Sap of the outward Coats, the outward Parts of Fruits, *&c.* that which remains in the Body betwixt the ſeveral Coats, and betwixt the Bark and Body, begins to condenſe there alſo, firſt into a Gelly, and after into Wood, Bark, Roots, *&c.* according to the ſeveral Places to which it hath ſubſiſted. And becauſe it condenſeth faſter in ſome parts than in others, according as they be higher or lower, whether it be by Heat or Cold, or Exhalation of thinner parts, the Sap condenſed above or below, filling leſs room, muſt needs cauſe the Sap, which is not yet condenſed in appearance, to deſcend or ſubſide, and to ſink as it were lower and lower, in the Pores of the Timber and Bark, *i.e.* to be leſs high, not deſcend from any place to which it was formerly riſen, unleſs, (as in Blood-letting) when ſome lower part is opened, all the Sap above continually flows thither till the Tree be emptied, or the continual Flux of the Sap (the natural Balſam of the Tree) heal the Wounds, as that of the Blood does thoſe of the Body; and ſo much quicker and eaſier, by how much the Air is more favourable, or is better kept out: which he obſerves for their Direction who are curious in Inoculation, as the ground of their Succeſſes or Miſcarriages. The Trees obſerved by the ſame Dr. *T.* to run, are the Vine; the Birch, plentifully at Body, Branches and Roots; the Walnut-tree, at the Roots and pruned Branches; ſome Willows and Sallies, and ſome ſorts of Maples; the Sycamore, which is the greater Maple (ſome call it a Plane) at a Gaſh made on the Bark of his Body, and at the Root and Branches; the Poplar and Aſp. Some Woodmen affirm, that in ſuch Oaks as are windſhaken, that have large Hollowneſſes in their Arms and Bodies, they have found great quantities of Sap in the cutting of them, whereof having drank, they quenched their Thirſt without any prejudice. To theſe add the Whitting or Quicking-tree (*Lat. Fraxinus Sylveſtris*, and by ſome, *Fraxinus Cambro-Britannica*) which in its Seaſon, as ſome affirm, will run plenteouſly, and whence they would have us expect a ſovereign Drink againſt ſome ſtubborn Diſtempers, eſpecially ſuch as are Scorbutical and Splenetick. I have kept (ſaith Dr. *T.*) ſome of the Juice of the Berries (which being expreſſed ferments of itſelf) theſe 2 Years in Bottles, and it hath the taſte of an auſtere Cyder; and I ſuppoſe, from its grateful ſmell, that it may be kept till it ripens, and become a ſtrong vinous Liquor. It is the Houſhold Drink of ſome Families in theſe parts about *Wales* and *Herefordſhire*; and ſome out of curioſity have brewed ripe Berries with ſtrong Beer and Ale, and kept it till it tranſcended all the other Beer in goodneſs.

Dr. *Tonge*'s Attempts upon the Poplar, Aſp, Elm, Oak, Aſh, Elder, Whitting-Berry or Quicking-tree, Thorn, Buckthorn, Tile, Nut, Sloe, Briar, Bramble, *&c.* have not ſucceeded; and he doubts that they, and all Apples and Pears, have ſome degree of Gummineſs in their Juices, ſo that they will not run.

4. The Sap apparently riſeth by the inward Bark, where you may ſee the Quick begin, and where the Graſs firſt incorporateth. Dr. *B.*

Dr. *T.* obſerves that there are Circles in Trees which are the Diſtances of thoſe Films or Coats, by which the Tree receives its yearly Increaſe in Thickneſs. Thro' theſe, looking full of circular Pores, the Sap ſeems to aſcend in the ſame manner between Coat and Coat, as between the Bark and the Body. Now the Aſcent of Sap is by all Parts and Pores of the Tree in ſuch ſmall Quantities, as can hardly be diſcerned, unleſs the Tree be quite ſawed off, eſpecially near the Root, for then it will appear how it aſcends. In Birches, and ſuch like, the Sap iſſues very plentifully in all parts of the Body, when they are cut down near the Root.

The Bark is double, outward and inward; the outward is dry, and in ſome Trees rough; the inner is probably a ſuperadded new Coat of that Year's Growth, or ſomething like it, between the nature of Wood and Bark. The Sap riſes within and without that ſuperadded Coat.

n. 46. p. 913. To perfect the Experiment about Sap, and to find whether it aſcends more or leſs in the prick'd Circles of the Body, than in thoſe betwixt the Body and the Bark; let the Tree, exempted from all its Sap the Day before, be firſt pierced with an Augre, only thro' the Bark, and the Quantity of Sap it yields in an Hour exactly meaſured and weighed; then at the ſame time, let another Hole be bored into the Body of the Tree, above an Inch and a half deep, and ſo round about on every ſide of the Tree, ſome deeper and ſome ſhallower, with a good large Augre, and one quite thro' ſloping. From which Experiment, after various Trials, may be found the difference of the Sap, riſing on the North and South; and ſo likewiſe of that which comes from the Bark only peel'd off, and that which aſcends in the inner part of the Tree. The Weight may be alſo compared of that which iſſues from the Bark, with that which iſſues from the Body. The internal Heart-Sap may alſo be drawn apart, by boring a ſmaller Augre-hole in the middle of a greater, and fitting it with a long Pipe adjuſted to that inner Orifice.

5. Dr. *Beal* ſaith, experimentally, that if a Circle be drawn round about any common *Engliſh* Tree, as Oak, Elm, Poplar, *&c.* by Inciſion, to the Timber (how thin ſoever the Knife be) ſo that no part of the Rind or Bark, to the very ſolid Timber, be uncut, the Tree will die from that part upwards. Only the Aſh (of all that I could try) will grow on and proſper, notwithſtanding the Inciſion. My Brother (*T. B.*) ſhewed me ſome old and huge Aſhes, which were bared of the Bark by the Deer, from the Root, 4 Feet upwards, quite round, yet they had continued their growth many Years, and ſome parts of the Bark which were left in few Places not ſo broad as the Palm of my Hand, had a freſh Verdure, more lively than the parts of the Bark which remained above the Baring. Yet if ſome Inciſions by Hackings be made, or if the Branches of ſome Fruit-Trees (eſpecially the Gennet-Moyle) be quite bared under a Knot near the Body of the Tree, and that Knot and bare Part be well covered with Loame, or good Mould in *June*, that Branch will not only ſurvive, but will be apt to take Root and become a young Tree of ſpeedy Growth, if cut off below the Baring, and ſet at a fit Depth at the

End of Autumn, or about *Candlemas* rather. Where ſuch tranſverſe Hackings are made, or Contuſions in the Bark, many Vegetables are apt to gather Knobs, and ſometimes ſmall Branches will ſpurt out above, and ſometimes about the Part contuſed. To get the Gum of the Plum-trees, I have ſometimes wrenched the Branch, till the ſolid Timber hath cracked, and the Rind forced open in ſome parts, ſo leaving it to grow; but forced to continue in a Poſture ſomewhat wreathed, it hath not failed to yield me Store of Gum next Summer.

Dr. *T.* A Branch whoſe Bark of the Breadth of about 2 or 3 Inches, is taken off round towards the bottom, in ſome Trees, and particularly the Lime-Tree, will live and bear Leaves for many Years, and grow as other Branches, by means of the Sap aſcending through all the Pores of the inner Coats, as was ſaid in the third Obſervation.

Vide infra, lxix.

6. The Juice which deſcends by tapping, and which maketh the Pulp or Coat of any Fruit, aſcends by the Bark or Rind of the Plant, and not by the Pith. But I can affirm by many Experiments, that the Pith and the Timber have ſome Correſpondence with the Seed of the Plant, to convey an Intercourſe of the ſame Spirits and Nature from the Root to the Seed. Dr. *B.*

Dr. *T.* ſaith, That Piths are of a very different Nature and Subſtance; in the Walnut is a multitude of Films, manifeſtly diſtant from one another; in others, as in Elders and Bryars, it is a continued ſoft, looſe, dry Subſtance.

7. The Points or Ends of the Roots being cut off, they will in proportion bleed as copiouſly as the Branches, and probably more, certainly longer, becauſe there is greater Plenty of Juice aſcended above them, than the Branches; and conſequently more will iſſue by them, than by any Part of the Tree higher than them. Dr. *T.*

8. From the latter end of *January* to the middle of *May*, Trees will bleed; thoſe that are ſaid to run firſt, are the Poplar, Aſp, Abele, Maple, Sycamore: ſome, as Willows, and the Birch, tried by myſelf, are beſt to tap about the middle of the 2d Seaſon; and the Walnut, towards the latter end of *March*. They generally bleed a full Month in the whole. Mr. *Midford* of *Durham*, a very expert Gatherer and Preſerver of Saps, affirms, that the Saps of the Poplar and Aſp riſe ſo briſkly in *January*, that they will bleed before the End of that Month; the Sycamore will run in hard Froſt, when the Sap freezes as it drops. Dr. *T.*

9. The beſt Time of the Day for Tapping is about Noon. In the latter Seaſon, when Sap is not very plenteous in Trees, they will neither run Morning nor Evening, nor probably at any time of the Night; but when they are very full of Sap, and emptied but by very ſmall Vents, the Sap may run Night and Day till exhauſted, but never in large Vents. I have often obſerved, that when a large Walnut would yield no Sap any longer in the Body or Branches at any time of the Day, it would run longer at the Roots on the South or ſunny ſide, than on the North or ſhady ſide, conſtantly governing the courſe of its Sap in its beginning to riſe, and to ſtop daily at the riſing and ſetting of the Sun.

By Dr. Tonge, *n.* 43. *p.* 862. *n.* 44. *p.* 880. *n.* 58. *p.* 1199.

10. Trees afford no Juice at all (that has been obſerved) in Autumn: But Birch-Trees bored in the Spring, ſo late, in reſpect both of the Year and Day, that they have afforded no Sap at all at the Body, have been found ſome time after, to have iſſued ſuch Plenty of Juice, as hath condenſed in the Hole to a ſtiff Gelly.

11. Rain being ſcarce, the Juice will be ſcarcer. Plenty of Rain can only give ſuch plenty of Sap, as the Pores will admit. And too much cold Rain may, by over-cooling, hinder the Sap, by abating from the Degree of Heat neceſſary to the Pulſion of Sap into the Root, and to the Digeſtion in the Tree: which is alſo in watering. On this ground it ſeems probable, that drawing Sap conſtantly from Trees every Year, will not hinder their Growth, in Body, Branches, Leaves, nor Fruit, to any great Prejudice; for Pulſion will ſtill ſupply Juice into the emptied Pores, till their Capacity be filled. It is alſo poſſible, that Trees may grow better, and give more Fruit, if the right Art of drawing Sap be found out for that end; as ſome Perſons grow fatter by often bleeding.

n. 44. p. 877. 12. In the Change of the Nature of a Tree, the Application of Juices is, in my opinion, not otherwiſe conſiderable than from the ſcarcity, plenty, or goodneſs, of the Nouriſhment of ſuch Juices; not from the Taſte, or Reliſh in them. Yet probably hot Nouriſhments, whether in Juices or Earths, may digeſt the Sap, and conſequently the Fruit better in Trees of flaſhy Fruit, than in others; and *vice verſa.* In the mean time to change the Taſte of Fruit, the probableſt way may be thought not very hopeful to bore the Roots and the Body, downwards and tranſverſe, and to fill the Holes with plenty of its own or ſome other Tree's Sap, in which ſome Aromatick Subſtances have been ſtrongly infuſed.

13. If no Rain come to the Roots of Trees at all, nor other Moiſture, they will not grow; but if the Points of the Roots only be watered, tho' all the reſt remain dry, (as it happens naturally in Fir-Trees) they may grow very well. For the Points of the Roots ſhoot out yearly a ſharp pointed tender Part, ſomewhat like the ſharp Bud on the End of a Sprig, by which the Root not only enlarges itſelf in the Earth, as the Branches do in the Air, but alſo receives its Nouriſhment: And that tender Part moves itſelf towards the beſt moiſtened and the tendereſt Earth. So that to promote the Growth of Trees, 'tis very effectual to looſen the Earth about the Points of the Roots; and there alſo to miniſter Nouriſhment or proper Liquors; and this in Trenches where the Amendment may remain, rather than above; throwing out the dead Mould out of the Trenches, and ſpreading it about to kill Weeds.

14. The Roots of Plum and Lime-Trees inoculated upon, will ſhoot out their Buds, as I have experimented. I failed of Succeſs in the Walnut, in regard I think I had not well provided for what was neceſſary to keep the part inoculated from the moiſture of the Earth and Rain. To make a ſucceſsful Tryal, ſuppoſe in an *Alkermes-Oak*, (a delicate Tree, and difficult to be otherwiſe inoculated upon) let the Root to be grafted on be bared in the Fall of the Leaf, taken out of the Earth, and at convenient diſtance from the Body of the Tree, bow'd, and raiſed a Foot above the Earth; and then the Points and

Fibres of the Root carefully laid about with freſh Earth, and watered till they take well, and till the Root raiſed in the Air have a Bark like that of a Branch of a Tree; which probably it will get in the next Seaſon of Inoculation. The Inoculation itſelf is made on the part raiſed after the ordinary Way. When it is done, let it be carefully covered with ſome ſoft Wax, as is known, to defend it from the Rain; it is to be ſtopped, and ordered in all things as in other Inoculations.

15. The Arms of the Roots of Trees, are to be cut for the Advantage of their Growth according to the Proportion they have to their Head and Body; or according to the Deſign you have to increaſe Wood or Fruit. For ſuch Roots as are more outward, feed Wood; ſuch as are inward, the Fruit.

16. The Depth of Trees to be ſet; ſhould never be below the reach of the Sun's Heat, nor the goodneſs of the Mould, and rather too ſhallow than too deep; for as much as they are apter to ſink lower, than to raiſe themſelves upwards, if they be out of the convenient reach of the Sun's Heat, the Cauſe of Pulſion and Nouriſhment.

17. The Seeds of Fir, Pine, *&c.* which bring up the Shells of their Seeds, upon the Heads of the firſt Shoot, will either not grow at all, or difficultly, if the blunt End be put downwards; becauſe in that Poſture it muſt turn it ſelf, before it can emerge into the Air, for the Root is ſhot downwards at the ſharp End: But it may very well grow, if ſet horizontally.

18. Such Trees as were mentioned in the firſt Obſervation, may grow, though no part of the Root be in the Earth. And all ſuch as may be propagated by ſhort Sticks cut off at both Ends and laid in the Ground, as Mulberries, will do. Some young Plants, if their Heads be kept moiſt, will live all Winter, if mild, though their Roots be in the Air, as I tried in Seedlings of Apples and Crabs. Their Roots afterwards in the Spring, grew and lived. The Reaſon why ſome Plants grow in Sticks, may be the Softneſs of ſuch Wood, apt thereby to receive Nouriſhment like a Root, and to ſhoot out Roots and Fibres from themſelves. But in ſome Slips, taken from firmer wooded Trees, as Bays, a moiſt temperate Seaſon is to be obſerved; and ſome Stone, or Chip of ſome Wood, to be cloſed to the End of the Slip, and ſet in the Earth with it, which helps its Rooting.

19. I am informed by a curious and intelligent Perſon, that the Corruption of Timber, depends not upon the time of the Year, and the Aſcent, or the Plenty or Scarcity of Sap, ſo much as upon the Seaſon of the Moon or Wind. And he affirms that Timber-Trees felled when the Wind is in the Weſt, eſpecially in the old Moon, will keep them free from Grubs (as they call it) *i. e.* from being Worm-eaten; and on the contrary, that when cut down in an Eaſt Wind, the Worm will ſeize on them, in what Seaſon of the Moon ſoever it be felled. To prevent which Corruption, it is adviſed that ſuch Timber be forthwith thrown into Water.

20. *Ethelbert Jay*, an ingenious and expert Planter in *Leimſter*, ſuppoſeth, that the fitteſt Time to inoculate, is preſently after *Midſummer*, becauſe, ſaith he, the Sap deſcends; but I ſay, becauſe it is then moſt plentiful, and begins to Jelly. The ſame aſcribes it to the Sap aſcending, to take the Bud inoculated

before

before *Midſummer*; and to the Sap deſcending, to take it after *Midſummer.* The time he limits to a few Days before *Midſummer*, and to eight or ten Days after it. Mr. *Auſtin* limits fourteen Days before, and as many after, and would have the Bud untied after fourteen Days, as I remember.

It is all one, whether the Sap be exhauſted below, by being converted into Wood, Roots, and other Uſes; or by Diverſion, as when the Branch is cut, or the Bark opened below: The Sap in both Caſes deſcends, or rather ſinks indifferently, to ſupply the Defect, and heal the Wound; and ſo it comes to paſs, that there being about *Midſummer* the greateſt Plenty of Sap in Apple-Trees, a Bud then inoculated will thrive, eſpecially before *Midſummer*; for then it draws its Share in the Sap aſcending; and all the neceſſary Uſes of the upper Branches being ſerved, it partakes of the Flood of the abounding and ſuperfluous Sap remitted to it from them.

21. My Friend informs me, that to cut off the Head of the Stock, above the inoculated Bud, will make a better Shoot, than in the uſual Inoculation; if this be done a few Days before *Midſummer*.

22. If the Sap in its ſubſiding, be conſiderable in the Matter of Inoculation, it ſeems that Inoculation will hold beſt and longeſt in Seaſon, in the Root. For I have obſerved the Sap to ſubſide unto the Roots out of the Body at ſuch times of the Day and Year, when in the Branches I found none to ſpare.

23. To make a barren Tree bear again, cheriſh it with Dung in Trenches, and pare and renew the Extremities of its longeſt Roots, and cut off the outermoſt and ſhorteſt, near the Body. Hence it may ſeem, that Plowing helps Fruit-Trees.

24. Croſs-Hackings promote Fruitfulneſs, cure the *Phyllomania*, whereof the Reaſon ſeems to be, that (as was above intimated) outward Circles and Barks feed the Wood, and the inner only reach out to the outermoſt Sprigs of the laſt Year, to which the Fruit is appendant. For ſome Trees bear only on this Year's Shoot, and ſome only on that of the laſt, poſſibly ſome only on the third Year's Shoots; and ceaſe bearing when they ſhoot no new Sprigs. Seaſonably bearing the Roots, which they call *Ablaqueation*, probably hath the ſame Effect, becauſe it hinders the Nouriſhment eſpecially of the outward Coats, and of Bark Leaves, and Suckers: But becauſe it ſeems that as ſome Suckers or Shoots, lately ſprung in outward Coats, rob the Fruit of the riſen Juice; ſo later Roots, come from the outward Parts of the main Roots, rob them alſo of their firſt Nouriſhment in the Earth. They ought to be pruned, as well as all Suckers and not-bearing Branches and Sprigs, every Year. For which Reaſon alſo Dung and other Amendments, as was ſaid above, ought to be applied in Trenches nigh to, and beyond the fartheſt Points of the Roots, to draw them out of the Shade and Drops. To this end, Diſtance and Situation is to be obſerved.

25. One of the beſt Ways of obtaining the greateſt ſtore of Sap in the ſhorteſt time from the Body of any Tree, is, not only to pierce the Bark, nor to cut the Body with a Chizel almoſt to the Pith (as ſome have directed) but quite through all the Circles, and the inner Rind itſelf, on both Sides of

the Pith, leaving only the outermoſt Circle and the Bark on the North-Eaſt ſide unpierced. But this Hole is to be bored ſloping upwards, as large as the biggeſt Augre you can get will make; and that alſo thorough, and under a large Arm, near the Ground; ſo will it not need any Stone to keep open the Orifice, nor Spigot to direct the Sap into the Receiver. This Way the Tree will in a ſhort time afford Liquor enough to brew with: And with ſome of theſe ſweet Saps, one Buſhel of Malt will make as good Ale, as four Buſhels of ordinary Water; though you ſhould brew even in *March*, held the propereſt time for Brewing, in regard to the Goodneſs of the Water at that Seaſon. Sycamore I take to yield the beſt brewing Sap, being very ſweet and wholeſome.

26. To preſerve Sap in the beſt Condition for Brewing, what you gather firſt, muſt be inſolated by a conſtant Expoſure of it to the Sun in Glaſſes or other fit Veſſels, till the reſt be gathered and ready; otherwiſe it will ſoon contract an Acidity. Having been thus expoſed to the Sun, till a ſufficient Quantity is collected; put into it ſo much very thin cut and hard toaſted, but no ways burnt, Rye-Bread, as will ſerve to ferment it; and when it works, take out the Bread, and bottle the Liquor; ſtopping it up with waxed Corks: If you bake Sage, or any other Medicinal Herbs, in ſuch thin Rye-Paſte, till they be very dry, you may expect a very wholeſome Drink. If you put a few Cloves into every Glaſs into which the Sap runs from the Tree, it will certainly keep a Twelvemonth: But I have wondered, whilſt I obſerved how ſpeedily it drew the Taſte and Tincture of the Clove. In ſome few Bottles I was ſo happy as to draw out my Cloves, with a Cloth in which I tied them up, in ſuch a Seaſon, as not to change Colour nor Taſte; and yet I preſerved the Birch-Sap by that ſlight Fermentation, above a Twelvemonth without any Alteration, which elſe would have ſoured in a few Days.

27. Some propoſe Oil of Sulphur to perfume the Bottles with.

28. Spirit of Wine ferments the Juice of ſome Berries, and poſſibly may not only preſerve but advance the Virtue of Saps, a little being poured on the Top of them in the Bottles, or ſome other oily Spirit.

29. Raiſins infuſed in the Liquor of Birch, is one Ingredient of the *Durham* Gardiner. I have been informed, that he uſes Sugar: But I believe, he puts it not in till he opens a Bottle preſently to be drunk, becauſe it maketh the Liquor ſparkle in the Glaſs.

30. A certain Lady ferments it with Rye-Toaſt, not put in, but only hung over it, in ſuch Quantity, and at ſuch Diſtance, as may give ſome light Warmth, Motion and Alteration to the Surface of the Liquor.

31. I fermented ſome with Ale-Balm, which converted my delicate Birch Juice, kept in Bottles, into pitiful ſmall Beer; which I wondered at, for I knew one who uſed, by the Barm of Ale, to improve ſmall Beer, and thereby to keep it the better in Bottles.

32. Honey will not mix with Cyder, though boiled therein to make Meath: But after a while the Cyder lets fall the Honey, and becomes ſimple Cyder again.

33. Some affirm, That the Tops and Leaves of Birch decocted in the Sap

will

will preſerve it from ſouring the whole Year; and that any ſort of dried aromatick Herbs, as Sage, *&c.* boiled in Beer, will keep as well as Hops, Ling, Heath, Broom, or Wormwood. I had a Friend who uſed Bay-Leaves in his Beer and Ale.

n. 58. 34. The Aſps run only (as Mr. *Milford* relates) before *February*; the Hop, about Hop-Harveſt, withers in *April.*

n. 68. 35. In thoſe Trees, whoſe Sap ſeems to be of a gummy Nature when condenſed, as Plums, Cherries, *&c.* I know no Experiment, by which any drop of Sap can be collected. And I ſuſpect, ſome other Fruit-Trees to be of that Nature, whoſe Sap I could not draw out, at any Seaſon, of hot or cold Weather, though they have not been obſerved to yield any Gum. Perhaps there may alſo be ſome Fruit and other Trees, whoſe Saps are viſcous, though not gummy; and theſe, I doubt, will not yield any Sap to be gathered in any common or known Way.

36. It is not feaſible to gather all the Sap of thoſe Trees, whoſe Juice is fluid and plentiful, and condenſeth into a Gelly; becauſe it ſeems at moſt Seaſons of the Year to aſcend imperceptibly, and that not only in the outward, but innermoſt Parts and Pores of the Tree, not only betwixt Bark and Wood, but betwixt every Coat of the Wood, and even through the moſt ſolid Parts of each Coat, as Mr. *Willoughby*'s Obſervations have diſcovered. *Vid. inf.*

37. An eminent Planter in *Glouceſterſhire* has diſcovered to us, that by binding the Trees round about very cloſely and ſtrongly with Cords, ſo as to intercept what riſeth betwixt the Bark and the Body, he retards their Bloſſom and bearing: And ſo may in ſome Years (when the open Weather haſtening Bloſſoms is like to deſtroy the Fruit) prevent a Scarcity of forward Fruit, uſually nipped by the late Froſts.

Ib. p. 2075. 38. I kept ſome Sap in a large Retort of two or three Gallons, expoſed Night and Day (without any other ſtop than the Obliquation of the Retort's Neck, and a little Paper to keep out Inſects) many Months, and it contracted a Coat on its Top; the Taſte pleaſing my Palate, I adventured to brew with it at Cyder Seaſon, and made a good Quantity of good Cordial-Drink, with eight Buſhels of chopped Apples, brewing them like Malt with hot Water, and putting my Juices and Saps into my Water Cyder at the latter end of their Boiling. I filled a Stand with it, which contained half the Quantity of the largeſt *Rheniſh* Wine Veſſel, *viz.* about forty Gallons, as I remember. I had not half Sap in this Liquor (the greateſt Part of my Brewing being made with Water) yet I got five Gallons and more of warming Cordial and pleaſant Drink for every Buſhel of my Apples. If it had been all Sap, it would have been much more cordial and ſtrong. There was in it a conſiderable Quantity of Juice of Borrage Roots and Herbs (at that Seaſon uſually thrown out of Gardens) which Borrage-Liquor works and purges itſelf when tunned, and turns into an excellent clear brown Liquor. I drank my Drink in *Eaſter* following: So my Sap gathered at Spring, and brewed about *Michaelmas*, continued good till *Eaſter*, and after it.

39. Some affirm, That the dividing of Crab-Stock Roots, from the Stem left in the Ground, is the beſt Way of multiplying Crab-Stocks, or a commendable one at leaſt.

40. 1. I have heard that a Chip of ſoft Wood, laid to the End of a Bay-Slip, promotes its rooting: And that Mulberry-Slips are eaſily propagated ſet in the latter end of *January*, or beginning of *February*, in a moiſt Seaſon, not in a dry *March*. Such Slips root beſt, if they be Suckers, and taken off with part of the old Bark; or if they be laſt Year's Shoots, cut off from Arms, taken with ſome older Bark from the Place where they ſhot out. I have ſet many formerly, which all throve. I affect to propagate them for Pear, and other Stocks, namely, Quinces, Medlars, Plums, to turn their Pulp and Juices red, by taking Grafts from ſuch Trees as have been grafted on Mulberries. Perhaps the Blood-red Pears and Redſtreaks were thus raiſed at firſt, or may be thus propagated to Advantage.

2. 1. In Birch-Trees, the Sap iſſues out at the leaſt Twigs of Branches, and Fibres of Roots, in proportion to their bigneſs.

By Mr. Fr. Willoughby, *and Mr.* Wray, n.48, p. 963.

2. In all Trees the Gravity promotes the Bleeding; ſo that from a Branch or Root, that tends downward, there will iſſue a great deal more Sap than from another of the ſame bigneſs in a more erect Poſture.

3. Branches and young Trees cut quite off when they are full of Sap, and held perpendicularly, will bleed, as we experimented in Willow, Birch, and Sycamore: And if you cut off their Tops, and invert them, they will bleed alſo at the little Ends. Hence one may conjecture, that the Narrowneſs of the Pores is not the ſole Cauſe of the aſcent of the Sap; for, Water that hath aſcended into little Glaſs Pipes, will not fall out again by its own Gravity, if the Pipes be taken out of the Water.

4. Roots of Birch and Sycamore cut aſunder will bleed both ways, that is, from that Part remaining to the Tree, and from the Part ſeparated; but a great deal faſter from the Part remaining to the Tree. But in a cold ſnowy Day, the Root of one Sycamore we had pared, bled faſter from the Part ſeparated; and ten times faſter than it did in warm Weather before.

5. In Birches the Sap does not iſſue out of the Bark, be it never ſo thick, but as ſoon as ever you have cut the Bark quite through, then it firſt begins to bleed.

6. The Bark being quite pared off, above an Hand's-breadth round, about ſeveral Birches, did much abate the bleeding of thoſe Trees above the pared Places, but did not quite ſtop it.

7. The Sap doth not only aſcend between Bark and Tree, and in the prickt Circles between the ſeveral Coats of Wood; but alſo through the very Body of the Wood. For, ſeveral young Birches being nimbly cut off at one blow with a ſharp Axe, and white Paper immediately held hard upon the Top of the remaining Trunk, we ſtuck down Pins in all the Points of the Paper as they appeared wet; and at laſt, when moſt of the Paper became wet, taking it away, but leaving the Pins ſticking, we found them without

any Order, ſome in the Circles, and ſome in the Wood between. And to confirm this further, we cauſed the Body of a Tree to be cut off aſlope, and then cut the oppoſite Side aſlope likewiſe, till we brought the top to a narrow Edge; ordering the matter ſo, that the whole Edge conſiſted of part of a Coat of Wood, and had nothing of a pricked Circle in it, which notwithſtanding, the Sap aſcended to the very top of this Edge, and wetted a Paper laid upon it.

8. To find out the Motion of the Sap, whether it aſcended only, or deſcended alſo, we boared a hole in a large Birch, out of which a Drop fell every 4th or 5th Pulſe. Then, about a Hand's-breadth juſt under the Hole, we ſaw'd into the body of the Tree, deeper than the Hole: Whereupon the bleeding diminiſhed one half; and having ſawed juſt above this Hole to the ſame depth, the bleeding from the Hole ceaſed quite; and from the ſawed Furrow below decreaſed about half: And it continued bleeding a great while after at both the ſawed Furrows, the Hole in the middle remaining dry. We repeated this with much the like Succeſs upon a Sycamore.

9. Some Trees of the ſame Kind and Age bleed a great deal faſter and ſooner than others; but always old Trees ſooner and faſter than young.

10. A Wound, made before the Sap riſes, will bleed when it doth riſe.

11. While we were making theſe Experiments, the Weather changed from warm to very cold; whereupon the bleeding in the Birches, which begun to abate before, ceaſed quite: But all the Sycamore and Walnut-trees, we had wounded, bled abundantly, (ſome whereof bled not at all, and thoſe that did, did ſo but ſlowly) and ſo continued Night and Day, when it froze ſo hard, that the Sap congealed as faſt as it iſſued out. The Cold remitting, the Birches bled afreſh, the Sycamores abated very much, and the Walnut-trees quite ceaſed.

12. We pierced two Sycamores on the North and South ſides, and both of them from equal Inciſions bled a great deal faſter from the North ſides, than the South; which is conſonant to the preceding Experiment.

13. We ſet ſeveral Willows with the wrong Ends downward, and cut off ſeveral Briars that had taken Root at the ſmall Ends. This 29th of *May*, 1669, the Willows have ſhot out Branches near two Foot long; and from the top of the Sets, which were a Yard high, the Briars have alſo grown backwards, from that part which we left remaining to the Roots at the leſſer Ends; they have great Leaves, and are ready to flower.

By Mr. Willoughby, *n.* 57. *p.* 1105.

14. Dr. *Tonge* found, by his Experiments in the Roots and Branches of Trees, that not only cold Weather, but cold Wind and Sunſetting ſtopped or abated the Motion of Sap in the Sycamore: But his Experiments were made in *February*, and ours towards the end of *March*. The Cold which cauſed that increaſe of the bleeding in the Sycamore and Walnut, happened upon the 23, 24, 25, 26 of *March*; and one Sycamore, which ceaſed to bleed from the 11th of the ſame Month, bled afreſh copiouſly from Wounds that had been made ſo long before. The Buds before the Cold, were juſt ready to open into Leaves, and the Sap had begun to coagulate above a Fortnight before. In *January* $16\frac{69}{70}$ making Inciſions in the Sycamore and com-

mon Maple immediately upon the relenting of the firſt Froſt, we found that they both bled, and faſter, as the Weather grew hotter; nor did the ſucceeding Cold promote, but rather hinder their bleeding. So that the learned Dr. doth moſt ingeniouſly conjecture, that the Aſcent of the Sap in Trees, depends upon a certain Degree of Heat, ſufficient to raiſe, but not to coagulate their reſpective Juices. In thoſe Months, wherein the Heat ordinarily falls ſhort of that Degree, an accidental Heat or Warmth of Weather promotes the bleeding; but in thoſe Months, wherein the ordinary Temper of the Air exceeds that Degree, an extraordinary Fit of colder Weather makes them bleed again.

15. In Walnut-Trees, we never yet found, that Heat promoteth their bleeding, but always Cold. From a wound made in a Walnut-Tree in *January*, and the beginning of this preſent *March* 16$\frac{69}{70}$, in mild Weather, nothing iſſued; but the Weather changing and growing colder, it bled plentifully.

16. *March* 11. 166$\frac{8}{9}$. Roots of Birch, great and ſmall, bled both ways; and about the ſame time, Sycamore Roots alſo. The ſame Birch which firſt began to bleed, *May* 3. 16$\frac{69}{70}$, bled three Weeks ſooner the Year before.

17. It was obſerved in *Autumn* 1669 by Mr. *Mart. Liſter*, that upon the firſt Froſt, which happened in *November*, a Sycamore bled copiouſly; ſo that the Sap cannot be ſaid to riſe in *January*, but immediately after the Fall of the Leaf, in this Tree.

18. After the Leaves were explicated in the Year 1670, we obſerved the Sycamore, after ſeveral froſty Nights, to bleed afreſh in the Morning, ſoon after Sun-riſing, when it had ceaſed ſeveral Days before; though this muſt not be underſtood of all Sycamores, but of ſome only that are more ſenſible and obſervant of the Weather.

n.58.*p*.1199.

April 3, and 4, all the Sycamores quite ceaſed.

The 5th being after a white Froſt, they began to bleed about 8 a Clock, and ceaſed towards Noon.

The 9, 12, 13, 15, they bled again.

The 16, they bled not, it being rainy, and the Sun not ſhining.

From the Obſervations we have hitherto made, we think it may be certainly inferred, that a Morning Sun after a Froſt, will make all the bleeding Tribe bleed afreſh, though they had before ceaſed, and that this new bleeding towards the latter end of the Seaſon commonly ceaſeth before Noon. Poſſibly ſome may bleed after a Froſt, yet further in the Summer.

19. I obſerved in *Auguſt*, a copious and ſpontaneous Exſudation, very like bleeding, of a viſcous yellow Juice, out of the Buds of a black Poplar.

20. Our Walnut-trees bleed here at *Middleton* in *Warwickſhire* in *January*.

By Dr. Tonge, *n*.68. *p*. 2070.

21. I am very much confirmed in my Apprehenſions, that Trees and other Plants, if we could contrive them, as I have (but ſlenderly) projected in my Sap, wiſer to that purpoſe, would far better indicate the Alteration

of Weather, as to Heat, Cold, Moiſture, Drought, or any Weather-glaſſes I have yet experimented. For my Weather-glaſs continuing at one and the ſame ſtation in a manner all this Day (*April* 13. 1670) my Trees have altered their Temper ſo much, that 24 of them that ran tolerably this Forenoon, yield not a Pint of Sap this Afternoon; and tho' one of them ran moſt part of the Day, the reſt ceaſed about one or two a Clock in a fair, clear, ſunſhiny Seaſon, retarded (ſo far as I could obſerve) only with a Weſtern Wind, though that be reputed mild and cheriſhing.

Theſe Trees ran above 2 Quarts in the Morning, the Weather-glaſs continues the ſame, *viz.* about 11 Inches Water theſe two Days. *Thurſday* 14. it was $9\frac{1}{2}$ only.

Friday 15. My Weather-glaſs at Noon was advanced from 9 to $10\frac{1}{2}$, yet the Quantity of Birch-water this Day exceeded my former from theſe Trees, for I had above $2\frac{1}{2}$ Quarts before Noon.

But for Cold, I find that the Air, when any whiſtling Blaſt of cold Wind ſtirs, ſtays my Birches.

Saturday, *April* 26. Theſe 24 Birches began to run preſently after Sun-riſe, and ran about 3 Quarts, and ceaſed about 2 a Clock after Noon, having till then continued to run.

Sunday 17. It rained ſo, that we could make no Obſervations what Sap theſe Trees might ſpend; neither did Rain and all amount to much above a Gallon and a half. *Monday* 18. they ran until Noon. *Tueſday* and *Wedneſday* the 19 and 20, wherein was expected greater Store of Sap, after the Rain the Trees ſpent not a Drop.

Saturday, *April* 23. My Weather-glaſs ſtood at $7\frac{1}{2}$, it being a rainy and boiſterous Morning, the Rain not allaying the Wind. At 9 a Clock of that Forenoon, my Birch-water worked in the Barrel, *per ſe*; which ſeems to verify Mr. *Souton*'s Relation from his Brother, a *Sweden* Merchant, importing that Birch-water in *Sweden* worketh alone (perhaps collected in great Quantity:) Only I put a few Cloves into my Sap, boiled to a third or leſs, it keeps well, eſpecially when boiled with the Buds or Sprigs of the ſame Tree, as I have been informed.

April 16, 17, 18. In the Year 1670, Birch-ſap mixed with Rain-water at the Tree, fermented with Roſemary-ſprigs, ſteeped in Spirit of Wine; which warmed the Stomach as ſtrong Wine, and pleaſed the Palate; tho' the Taſte in the Mouth was ſomewhat wateriſh.

By Mr. Fr. Willoughby, *n* 70. *p.* 2125. *Vide infra.*

22. We find that Branches of Willow, Birch and Sycamore, cut off and held perpendicularly, will bleed without tipping, and that the cutting off of their Tips does not ſenſibly promote the bleeding.

We doubt not of Mr. *Liſter*'s Diligence and Veracity, and wonder our Experiments ſhould differ. The Sycamore bleeds upon the firſt conſiderable Froſt, after the Leaf is fallen, as it did plentifully *Nov.* 16. 1670. And both that Walnut and Maple bleed all Winter long, after Froſts, when the Weather relents, and the Sun ſhines out; but Walnut and Maple begin not ſo ſoon as the Sycamore. The Birch will not bleed till towards the Spring, *An.*

$167\frac{1}{1}$

167$\frac{2}{3}$ it began ſomething ſooner than ordinary, about the beginning of *February*.

23. In a very ſharp Froſt the Bleeding is ſtopped till the Weather begins to change, but in a moderate Froſt, tho' it ſtop in the Night, yet in the Daytime, if the Sun ſhines out, the Trees will bleed though the Froſt continue. What we ſaid formerly, that cold did not promote, but hinder bleeding, we find holds true if the Cold be without Froſt. *Ib. p.* 2142.

24. We cut off pretty big branches of Birch, and having tipped the Ends, inverted them, and faſtned a *Limbus* or Ring of ſoft Wax to the great Ends, which we held upwards, making with the Plane of the End, a Veſſel of about an Inch deep, whereinto we poured Water, which in a few Minutes ſunk into the Pores of the Wood, and running quite thro' the Length of the Branch, dropped out of the Ends conſiderably faſt, continuing ſo to do as long as we poured on Water. The like Experiment we made by faſtning ſuch Rings of Wax to the leſſer Ends, and pouring in Water, which ran thro' the Wood, and dropp'd out of the greater Ends as faſt or faſter: This we tried once upon a Sycamore without ſucceſs; but afterwards I made trial both upon Sycamore and Walnut, and found that Water runs through both, but nothing ſo faſt as thro' Birch. *Ib. p.* 2126, *Ib. p.* 2142.

3. 1. About the beginning of *Nov.* 1669, I pierced a Sycamore growing in a ſandy Soil at *Nottingham*, the turgeſcene of the buds inviting me thereto, and engaged my keeping a Journal till the latter end of *March* following: from which Journal I think I may note, 1. That the wounded Sycamores never bled, neither in *November*, nor *December*, nor *January*, nor *February*, nor *March* (which yet they did above 40 ſeveral times, that is, totally ceaſing, and then beginning a-new) unleſs there preceded a ſenſible and viſible Froſt; for I had no other Way of recording the Temper of the Air. 2. That the Froſt did not always ſet a bleeding the Wounds they found made before they came, tho' ſometimes they did; but upon their breaking up, or very much relenting, the Wounds, either made at that Inſtant of time, or made many Months before, did never fail to bleed more or leſs. 3. That particularly upon the breaking up of the two great and long Froſts (the firſt of which happened that Year in that Country to be on the 3d of *January*, the ſecond about the 12, 13 and 14 of *Feb.*) all the Wounds ran moſt plentifully, ſo that ſuch Times may be looked upon as the moſt proper Seaſon of gathering great Quantities of Juice from this Tree. *By Dr. Liſter, n.* 68. *p.* 2067. *n.* 70. *p.* 2120, 2126.

2. In *May* 1670, I wounded ſome Sycamores in *Craven*, but they did not bleed, neither the remaining part of that Month, or the following Months of *June* and *July*; but had the Orifice of the Wounds made with a ſmall Augre, in a many quite grown up, and would ſcarce admit a Pigeon's Feather. Wherefore the 30th of *July*, I cut out a ſquare piece of about 2 Inches of the Bark of a large and well grown Sycamore about my height, in the Body of it. This Wound began to run next Morning about 9 a Clock, ſo as to drop, and that was all, and dried up by 11 in the Morning; the like Cut I made in a young Sycamore, the 8th of *Auguſt*, which in like manner bled the next Morning, but ſtopped before 9 a Clock. It did ſo for 2 or 3 Days; but then totally dried.

3. *November* 1. 1670. Here at *York* I pierced and otherwiſe wounded 2 Sycamores growing in a wet Clay, but they never ſtirred till the beginning of *February* following. Yet Mr. *Wray* hath aſſured me, that thoſe of *Warwickſhire* bled the 16th of *November* copiouſly, and afterwards the Walnut-Tree alſo.

I am apt to think that the Sap in all Parts of the Tree, at the times of this anomalous Bleeding, is ſome ways notably altered in its Temper and Conſiſtence: and this Bleeding by ſtreſs of Weather may in theſe Trees probably be looked upon as a Violence done to their Natures from an unkind Climate, conſidering the Walnut and Sycamore as Strangers, and not Natives of *England*. It is indeed true, there are many ſorts of *Engliſh* Plants, which will bleed in Winter; but note alſo, that ſuch Plants never refuſe to do ſo at any time of the Year, no more than a Man, who may bleed a Vein when he pleaſeth.

4. *Feb*. 1. $167\frac{0}{1}$, it froze, the Wind at *North*, the Froſt and Wind continued (ſome little Snow and Rain falling) the 2, 3, 4, 5, 6, until the 7th in the Morning, when the Wind came about to the *South-Eaſt*, and the Weather broke up apace. The Sycamores bled not all this while; but the 7th about Noon all Trees of that kind bled very freely, both at the Twigs and Body, and I ſtruck above a Dozen.

At this ſame critical Seaſon, I alſo ſtruck the Hawthorn, Hazel, Wild-Roſe, Gooſeberry-buſh, Apple-tree, Cherry-tree, Blather-nut, Apricock, Cherry-Laurel, Vine, Walnut; yet none bled but the laſt named, and that faintly in compariſon of the Sycamore.

Feb. 11. All was here covered with a white Froſt betwixt 9 and 11 in the Morning.

The Weather changing, I made the Experiments which follow, upon the Sycamore, Walnut, Maple. A Twig cut aſunder would bleed very freely from that Part remaining to the Tree; and for the Part ſeparated, it would be altogether dry, and ſhew no Signs of Moiſture, altho' we held it ſome pretty Time with the cut End downwards; but if this ſeparated Twig was ever ſo little tipped with a Knife at the other End, it would forthwith ſhew Moiſture at both Ends: The ſame Day, late in the Afternoon, the Weather very open and warm, a Twig cut off in like Manner, as in the Morning,
Ib. p. 2128. would ſhew no Moiſture at all from any Part. But I have ſince been convinced, that it was rather ſome unheeded Accident which cauſed this new Motion of the Sap, than merely the ſtriking off their Tops.

Ib. p. 2123. 5. Becauſe Sap is ſaid to aſcend from the Root; when it is found, to move in tapping, I lopped off certain Branches of a Sycamore, the Morning betimes of a hard Froſt (*Feb*. 21.) before they would bleed, or ſhew any Sign of Moiſture. And not willing to wait the change of the Weather, and the Sun's Heat, I brought them within the Air of the Fire; and by and by, as I expected, they bled apace, without being ſenſibly the warmer.

This Experiment repeated, afforded me divers *Phenomena*, which follow; and proved almoſt an univerſal Way of bleeding all ſorts of Trees, even thoſe which of themſelves would not ſhew any Signs of Moiſture.

1. Poles of Maple, Sycamore and Walnut, cut down in open Weather, and brought within the Warmth of the Fire, did bleed in an inſtant. Alſo Willow, Hazel, Cherry, Wood-bine, Blather-nut, Vine, Elder, Barberry, Apple-tree, Ivy, *&c.* Whicking and Egge-berry-tree (*i. e. Padus Theophraſti*) tried in the ſame manner in *Craven.*

2. Briar and Raſpberry-rods were more obſtinate; Aſh utterly refuſed; even heated hot.

3. Branches, that is, Poles with their Tops entire and uncut, bleed alſo when brought to the Fire-ſide; but ſeem not ſo freely to drink up their Sap again when inverted, as when made Poles.

4. The ſame Willow-poles left all Night in the Graſs-plot, and returned the next Day to the Fire-ſide, bled afreſh.

5. Maple and Willow-poles bleed and ceaſe at Pleaſure again and again, if quickly withdrawn and ballanced in the Hand, and often inverted to hinder the falling and expence of Sap; yet being often heated, they will at length quite ceaſe, tho' no Sap was at any Time ſenſibly loſt. And when they have given over Bleeding, that is, ſhewing any Moiſture, by being brought within the Warmth of the Fire, the Bark will yet be found very full of Juice.

6. An hard Ligature made within a quarter of an Inch of the End of a Wood-bine Rod did not hinder its Bleeding at all, when brought within the Warmth of the Fire.

7. Maple and Willow-Poles, *&c.* quite pared of Bark, and brought to the Fire, will ſhew no Moiſture at all in any Part.

8. One Barberry or Pipridge-Pole, bared of its Bark brought to the Fire, did ſhew Moiſture, from within the more inward Circles, though not any from the outward.

9. Maple and Willow-poles, *&c.* half bared of Bark, would bleed, by the Fire, from the half only of theſe Circles, which lay under the Bark.

10. Maple and Willow-poles, ſplit in two and planed, would not ſhew any Moiſture on the planed Sides, but at the Ends only.

11. A Pole of Ivy did of itſelf exſudate and ſhew a liquid and yellowiſh Reſin from the Bark and near the Pith; but when brought to the Fire ſide, it bled a dilute, thin and colourleſs Sap from the intermediate Wood-Circles.

12. A Pole of Willow (for Example) bent into a Bow, will ouſe its Sap freely, as in Bleeding either ſpontaneouſly or by the Fire.

13. One or both Ends of the Pith of a Willow-pole, ſealed up with hard Wax, will yet freely bleed by the Warmth of the Fire.

14. *March* 33, 167$\frac{0}{1}$, was the greateſt Froſt and Snow we have had this Winter in theſe Parts about *York*, when ſome Twigs and Branches of the very ſame Willow-tree as formerly, and likewiſe of many other Willow-trees, taken off that Morning, being brought within the Air of the Fire, would ſhew no Moiſture at all; no not when heated warm, and often and long turned. *Ib. p.* 2126.

15. *Mar.* 24. The ſame Willow-branches, which the Day before would not bleed, and were thrown upon the Graſs-plot all Night, did, both they and other

new cut down, by the Fire-ſide freely ſhew Moiſture, and bleed in the Morning upon the breaking up of the Froſt.

16. Aſh-Poles and Branches that Day, and the Day before, would by the Fire be no more moiſt, than when I formerly tried them.

17. The ſame Morning, a Twig of Maple which had had the Top cut off the 7th of *Feb.* (and which then bled) being quite taken off from the Tree, and brought within the Air of the Fire, and held with the formerly cut end downwards, did not run at all at that end; but held on in that Poſture, it did run apace at the other new cut End uppermoſt, ſo as to ſpring and trickle down.

Note, That this doth well agree with my Experiments made the Year before at *Nottingham*, where I obſerved Wounds of ſome Months ſtanding, to bleed apace at the breaking up of every hard Froſt. For in theſe Parts there hath been no hard Froſt this Year; not comparable to that Year. Again, thoſe *Nottingham*-Trees I wounded in the Trunk, and they ſtood againſt a Brick-Wall, and the Wounds were on the ſide next it; and beſides had horſe-dung ſtopped in all of them, for ſome Reaſons, which things did undoubtedly defend them much from the Air and Winds, and kept the Wounds ſtill green and open; whereas the Tops of theſe Maple-twigs ſpoken of in the laſt Experiment, were expoſed in an open Hedge to the Air and Winds; as alſo the two Sycamores here at *York*, mentioned above to have been wounded in *Nov.* 1670. and not have ſhewed any Signs of Moiſture, for that very Cauſe, that they were not freſh ſtruck at Bleeding Times.

The Circulation of Saps, by Dr. M. Liſter, *n.* 70. *p.* 2122.

LXI. I am inclined to think, that there is ſome Kind of Circulation of the Juices of Vegetables; 1. Becauſe I find, that all the Juice of a Plant is not extravaſate and looſe, and like Water in a Sponge, but that there are apparent Veſſels in Plants analogous to Veins in Animals, which thing is moſt conſpicuous and clear in ſuch Plants, whoſe Juice is either white or red, or Saffron-coloured; for inſtance, in each kind of Juice we propoſe *Lactuca Attractilis*, and *Chelidonium majus*. 2. Becauſe that there are very many Plants (and theſe laſt named are of the Number) whoſe Juice ſeems never to be at reſt, but will ſpring at all Times, freely as the Blood of Animals, upon Inciſion.

The Way of Ligature by metalline Rings, is an Expedient I have not uſed; but other Ligatures I have, upon a great number of our *Engliſh* Plants, not without the Diſcovery of many curious *Phænomena.* The ſucceſs of an Experiment of this Nature upon *Cataputia minor*, *Lob.* was as follows; I tied a Silk-thread upon one of the Branches of this Plant as hard as might be, and not break the Skin. There followed no greater Swelling that I could diſcern, on the one ſide of the Silk than on the other; although in often repeating the Experiment, ſome Silks were left Hours and Days unlooſed; and yet the Dimple which the Thread had made in the yielding Branches, had a little raiſed the immediate Sides, but both alike. The Plant in like manner would bleed very freely, both above and under the Tye. This was alſo, I thought, very remarkable, amongſt other things, in this Experiment, that in drawing the Razor round about the Branch juſt above or below the Tye, the milky Juice would ſuddenly ſpring out of infinite ſmall Holes, beſide the made Orifice, for more than half an Inch above and below the Tye: which ſeems to argue, that tho' there was no Juice intercepted in Appearance from any Turgeſcene, as in the Proceſs upon the Members of a *ſanguineous* Animal, yet the Veins were ſo over-thronged and full, that a large Orifice was not ſufficient to diſcharge the ſudden *Impetus*, and Preſſure of a ſome ways ſtreightened Juice.

The Deſcent of Sap in Winter, by Mr. Rich. Reed, *n.* 70. *p.* 2124.

LXII. 1. To prove that the Sap does deſcend in Winter, I have obſerved, that the Graft hath influence either to corrupt or to heal the Stock: nay, farther, to alter and change the very nature and way of the growing of the Root in the Earth, which I cannot ſee how it ſhould do, but by ſending down its Sap thither. I have by certain Obſervation found, that Crabſtocks grafted with ſome ſorts of Fruits which the Soil liketh not, they, not the Soil, will (not one or two, but all of that ſort) canker, not only in the Graft, but the Stock alſo; which if you graft again, upon the former Graft, with a Fruit liking to the Soil, will all heal, and ſo become Trees. And further, certain it is by my Obſervation, that 20 Pear-ſtocks being wild, grafted young with the ſame ſort of Pear, and 20 with another, the Roots of each of them of one ſort will grow alike, and ſo thoſe of the other. Generally, thoſe that naturally grow high, as the Bare-Land-Pear, Root deep, and all do ſo: Thoſe whoſe heads are buſhy and thick, as the *Summer-Boncbreſtein*: their Roots run wide, and are matted below, and all are ſo. This Diverſity of the way of growing of the Root, muſt be by grafting; and could not be but by the Intercourſe of Sap, which it received from the Graft; and that cannot be, but by the Return of Sap.

By Dr. J. Beal, *n.* 71. *p.* 2144.

2. 'Tis no wonder if the Effects which Mr. *Reed* mentions do follow from that Correſpondence in all Parts of the whole Plant, which is by me acknowedged, eſpecially, ſince by the Leaves and all the Pores in the Branches and Body, the Plant draws a kind of Suſtenance from the Sun, Air, and Dews, as by the Roots from the ſucculent Soil. And as the Channels, which I may call the Conduits and Strainers, of ſeveral Stocks, and Coyns do differ, ſo may ſome Change of the Liquor be made by ſeveral kinds of diſtillation. And from the fore-noted Difference of Stocks, and the differing Grains of the Roots and Timber, as alſo from the differing Leaves, if accurately inſpected, and conſidered, we may in time perhaps diſcover ſome particular Cauſes of the differing Sap, Fruit and Bloſſoms.

'Tis about 15 Years ſince I publiſhed a Hint, how to diſcover by the Colour, Figure, Tenderneſs and Aſperities of the Leaves of young Apple-Plants and Crabs, firſt appearing in the Spring, which Plant would yield the more delicate, and which the more auſtere Fruit and Liquor, to ſeveral Kinds and Degrees of Delicacy and Auſterity, Flatneſs and Inſipidneſs, and Vigour and Briſkneſs. And this, I think, allows a Conſideration for ſome Efficacy, or Sign, at leaſt, of Change or Operation in the Deſcent of Sap. But as far as I dare, or did, deny the Deſcent of Sap, I meant it in the vulgar Senſe of that Expreſſion, *viz.* the main Quantity of Sap which aſcends in the Spring, and is gradually hardened into Leaves, Bloſſoms, Fruit, Timber; in ſuch manner as the *Oſſification* in young Animals, is deſcribed by Dr. *Kerkringius. Anthrop. Ichn.* 'Tis a large Quantity of Sap, which is expended on the Fruit and Growth of ſome Trees, or Acorns, Walnuts, Cheſnuts; and this returns not to the Root in Winter: Yet conſiſts well with the Sentiment of the Circulation of the Sap, which in ſome Seaſons may run the round more ſwiftly than in other.

Veins in Plants obſerved by Dr. M. Liſter, *n.* 79. *p.* 3052.

LXIII. 1. Some Years ago, I made a few Obſervations concerning the Veins, or ſuch *Ductus*'s, as ſeem to contain and carry in them the nobleſt Juices of Plants; and I am of Opinion that they will prove Veſſels analogous to our humane Veins. Thoſe Parts of a Plant, which *Pliny* calls by the names of *Venæ* and *Pulpæ*, are nothing elſe in my opinion, but what Dr. *Grew* calls Fibres and Inſertments, or the lignous Body interwoven with that which he takes to be the cortical, that is, the ſeveral Diſtinctions of the Grain. But that theſe Veſſels are not any of the Pores of the lignous Body (to uſe the Doctor's Terms) is plain in a tranſverſe Cut of *Angelica Sylveſtris magna vulgatior*, *J. B.* for example; the Veins there very clearly ſhew themſelves to an attentive View, to be diſtinct from Fibres, obſervable in the *Parenchyma* of the ſame cortical Body together with themſelves; the milky Juice ſtill riſing beſides, and not in any Fibre. Alſo in the like Cut of a Burdock in *June*, the like Juice ſprings on this and on that ſide of the *Radii* of the woody Circle, that is, in the cortical Body and Pith only. Again, where there is no Pith, there is none of this Juice to be obſerved, and conſequently none of theſe Veins; as in the Roots of Plants, and Trunks of Trees; but ever in the Bark of either. Theſe Particulars are plainly obſervable in the *Spondylium*, *Cicutaria*, many of the Thiſtle-kind, *&c.*

Further, neither are they probably of the Number of the Pores, deſcribed by Dr. *Grew*, in the cortical Body, or Pith: Not ſurely of thoſe Pores extended by the Breadth, becauſe the Courſe of the Juice in theſe Veſſels is by the Length of the Plant; as I have ſometimes very plainly traced in the Pith of a dried Fennel-ſtalk, following them by Diſſection quite thro' the Length of the Pith. It remains, that if Pores, they are of thoſe Pores of the cortical Body, that are ſuppoſed to be extended by the Length thereof; which yet ſeems (to me at leaſt) not enough: But we think them Veſſels inveſted with their own proper Membranes, analogous to the Veins of our humane Body; for theſe Reaſons, 1. Becauſe they are to be found in the Pith, and ſometimes in the cortical Body of a Plant, not included within the common Tunicle of any Fibres, as is above noted. That Fibres, or the ſeminal Roots, are clothed, is moſt plain in ſome Plants, as in

Fern and *Geranium Batrachoides*; the Fibres of the former are coated, at leaſt in ſome Parts of the Plant, with a black Skin, in the latter likewiſe with a red one. And in theſe caſes, had they not, I ſay, their own proper Membranes, we ſee no cauſe why the very porous and ſpongy Body of the Pith, and *Cortex*, ſhould not be in all Places filled alike with the Juice, and not riſe (as moſt plainly it doth) in a few determinate and ſet Places only, that is, according to the Poſition and Order of theſe Veſſels. 2. Again, the Experiment I made concerning the Effect of a Ligature on *Cataputia minor Lobel*, *viz.* The ſudden ſpringing of the milky Juice out of the infinite Pores *Vid. ſupra Sect.* LXI. beſides the Inciſion, (the cauſe of which *Phænomeon* I take to be the diſſected Veins impetuouſly diſcharging themſelves of Part of their Juice within the porous *Parenchyma* of the Bark;) whence it is probable, that if there was no coated Veſſel to hold this milky Juice, we might well expect its ſpringing upon the bare Ligature, as when we ſqueeze a wet Sponge, the external Cuticle of the Plant, as this Experiment ſhews, being actually perforated.

In the next place, it is very probable, that theſe Veſſels are in all Plants whatſoever. For, as it is truth-like of all the other ſubſtantial Parts of Plants that they are actually in, and common to all Plants, tho' ſpecified by divers Accidents in Figure and Texture; ſo of theſe Veins, which tho' they be diſcernable moſtly in thoſe Plants where they hold diſcoloured Juices, yet we may very probably think, that they are not wanting, where the Eye finds not that Aſſiſtance in the challenging of them. And in theſe very Plants, where they are leaſt viſible, there is yet a time when they are, if not in all, yet in ſome parts of theſe Plants, plain enough to the naked Eye. The tender Shoots of the greater and leſſer Maple in *May* are full of a milky Juice, *viz.* the known Liquor of theſe Veins. Again to this purpoſe, if you apply a clean Knife-Blade to a tranſverſe Cut of the like Shoots of Elder, the gummy Liquor of theſe Veins will be drawn forth into viſible Strings, as is the nature of Bird-lime, of the Bark of Holly, or the Milk of *Cataputia minor Lobel.* Further, the Leaf-ſtalks of our Garden-Rhubarb do ſometimes ſhoot (by what Accident we enquire not here) a tranſparent and very pure chryſtalline Gum, tho' the Veins that held this gummy Juice, are by no ordinary means viſible in them; and yet by comparing the Nature and Properties of this Gum, with that of the Gums of other Vegetables, we cannot doubt but this Gum Rhubarb is the Juice of thoſe Veins, as well as we are aſſured, the Gum of other Vegetables to be of theirs, by the ſame comparative Anatomy. Laſtly, we think, that even Muſhrooms, that ſeemingly inferior and imperfect Order of Vegetables, are not exempt and deſtitute of theſe Veins, ſome of them yielding a milky Juice, hot and fiery, not unlike ſome of the Spurge-kind, or *Euphorbium.*

The primary uſe of theſe Veins is, in my opinion, to carry the *Succus nutritius* of Plants; becauſe where they are not, there is no Vegetation; as it is ſeen if an engrafted Branch or Arm be bared and ſtripped off the Clay, *&c.*

in *June*, all the Courſe of Vegetation will appear to have been made only by the Bark, and not by the Wood, that is, in the Place only where theſe Veins are. A ſecondary Uſe is the rich Furniture of our Shops: For, from theſe Veins only it is, that all our Vegetable Drugs are extracted, and an infinite more might be had by a diligent Inquiry, and ſome eaſy Means which I have not unſucceſsfully put in practice.

n.90.p.5132. To the foregoing Obſervations I ſhall here add others of later Notice; as the Skin of a Plant may be cut ſheer off with Part of the ſpongy *Parenchyma*, and no ſigns of milky Juice follow, that is, no breach of a Vein: Again, we have ſtripped the Plant of its Skin, by pulling it up by the Roots, and expoſing it to the wet Weather, until it became flaccid as a wet Thong, without any Injury to the Veins, which yet upon Inciſion would freſhly bleed. Theſe Experiments make againſt the general Opinion of one only Sap, *looſely* pervading the whole Plant, like Water in a Sponge.

In the tranſverſe Cuts of Plants, we ſee as it were a certain Order and Number of the bloody Orifices of diſſected Veins.

We obſerve alſo in a Leaf, which we take to be the ſimpleſt Part of a Plant.

1. That the Veins keep company with the Ribs and Nerves (as we vulgarly call them) and are diſtributed into all the Parts of the Leaf, according to the Subdiviſions of thoſe nervous Ligaments, and are diſpoſed with them into a certain Net-work; whether by Inoſculations or bare Contact only, we pretend not to determine.

2. That in a tranſverſe Cut of a Leaf, the middle Fibre, or Nerve, for Example, ſeems to yield one big Drop of a milky Juice, ſpringing as it were from one Vein; yet the Microſcope plainly ſhews us, that there are many Veins which contribute to the making up of that Drop.

3. That if a Fibre, or Nerve, be carefully taken out of the Leaf, the Veins will appear in it, like ſo many ſmall Hairs, or Pipes, running along, and ſtriping the Nerve.

4. That thoſe many Veins are all of an equal bigneſs, for ought we have yet diſcerned to the contrary.

5. That though we ſeem to be more certain of the Ramifications of the Fibres wherein theſe Veins are, yet we are not ſo, that thoſe Veins do any where grow leſs and ſmaller; though probably it may be ſo. That which makes us doubt it, is the exceeding Smalleſs of theſe Veins already; even, where we might probably expect them to be Trunk-Veins, and of the largeſt Size: And being there alſo in very great Numbers, and running in direct Lines along the Fibre, we gueſs that one or more of them may be diſtributed and fall off either hand, with the Subdiviſions of the Fibres, and ſuffer any Dimunition in their Bulk.

6. That we cannot diſcern any where, throughout the whole Plant larger or more capacious Veins, than thoſe we ſee adhering to the Fibres of the Leaves which do alſo appear, from comparing the bleeding Orifices in a tranſverſe Cut. I have found it a difficult and laborious Taſk to trace and unravel them, throughout the whole Plant.

Our Opinion is, That theſe Veins do ſtill keep company with their reſpective Fibres. And as all the Fibres of the Leaf are joined in the Stalk of the Leaf, and that Stalk explicated in clothing the Twig or Stem of the Plant (which we take to be the Reaſon of the orderly breaking forth of the Leaves) ſo do we think of the Veins, their perpetual Companions.

And as we have ſaid, the Fibres of the Leaves are joined in the Twig; ſo are thoſe of the Twigs in the Branches; thoſe of the Branches in the Trunk or Body of the Tree. The like alſo in an inverted Order we ſeem to obſerve in the ſeveral Coats and Ramifications of the Root. This the ſeveral Circles of Bleeding Orifices in tranſverſe Cuts, ſeem to confirm.

But moreover, in the Roots of Plants, if a ſimple Coat be ſeparated and expoſed betwixt your Eye and the Light, the Veins appear to be ſtrangely entangled and implicate, and not in the ſame ſimple Order as in the Leaves. The like we think of the Bark of the Bodies of Trees, which we cannot diſtinguiſh from the Roots of Plants: Though there is indeed, ſomething (at leaſt at certain Seaſons of the Year) in the Root, which is not to be found in any Part of the Plant beſides.

From what has been ſaid, it may well be doubted, whether there is any *Sinus*, or common Trunk, into which all the Veins are gathered: But rather, that there are a multitude of equally big Veins, each exiſting apart by itſelf. We indeed have found it very difficult, ſo to exhauſt the Plant of its milky Juice as to kill it, though we have given it very many Inciſions to that purpoſe. Divers other Inſtances there are, which favour the Diſcontinuance of the Veins, and the little Relation and Intercourſe they have with one another; as one Branch of a Tree having fair and well grown Fruit, before the other Branches of the ſame Tree and Fruit bloſſom, or have Leaves; from the different Situation and other Circumſtances of Culture, the indefinite and perpetual Growth of a Tree, the *Cyon* governing, *&c.*

The Subſtance of theſe Veins ſeems to be as truly membranous, as the Veins of Animals. A Leaf will not give way and be extended, but the Veins in a Leaf, if freed of all the woody Fibres, will be ſtretched out to one third Part at leaſt, and vigorouſly reſtore themſelves again, juſt like a Vein, Gut, or any other membranous *Ductus* of an Animal. Again, theſe membranous Pipes are exceeding thin and tranſparent, becauſe they ſuddenly diſappear, and ſubſide after their being exhauſted of their Juice; and particularly, in that we ſee the Liquor, they hold, quite through them, no otherwiſe than the Blood through our Veins; or (in *Chelidonium majus*, for Example) a Tincture of Saffron in Chryſtalline Pipes.

In the keeneſt Froſt which happened the other Winter, we diſſected the frozen Leaves of the Garden Spurge. Here we obſerved, that all the Juice (beſides that which theſe Veins hold) was, indeed, frozen into perfect hard Ice, and to be expreſſed out in the Figure of the containing Pores; but the milky Juice was as liquid as ever, though not ſo briſk as in open Weather. This Experiment we take to be good Proof of the Perfection of this milky Juice, and that it hath within itſelf ſo great a Degree of Fermentation, that it preſerves itſelf, and conſequently the whole Plant, from the Injuries of the Weather; that is, the Plant owes its Life to it. Thus we have ſeen Inſects (as Hexapode-Worms, *&c.*) lie frozen upon the Snow into very Lumps of Ice; and yet put under a Glaſs, and expoſed to the Warmth of the Fire, they quickly recovered their Legs, and Vigour to eſcape; which we think could not be, unleſs the vital Liquor of their Veins, as in this Inſtance of Plants, had been untouched, and little concerned in the Froſt. Further, we hence alſo urge the different Uſes as well as Natures of theſe Juices, and look upon the frozen Icicle, or that copious dilute and limped Sap, as alimental; the milky and not frozen Juice, as the only proper venal.

As to the Motion of theſe Juices, theſe Things are certain:

1. That the milky Juice always moves and ſprings briſkly upon the opening of a Vein: The limpid Sap but at certain Seaſons, as it were by Accident, and not, as I judge, from any vital Principle, or Fermentation of its own.

2. The venal Juice hath a manifeſt inteſtine Motion, or Fermentation, within itſelf. Witneſs, beſides what hath been juſt now ſaid of it, its contributing, and the long Continuance of, that Motion to the moſt inſenſible of Liquors; and likewiſe its thick and troubled Bleeding, like the riſing of Yeaſt, which yet in a few Hours after drawing, falls, and the Juice becomes tranſparent, as the Gum of the *Virginian Rhus*, &c.

We think indeed, (according to the Knowledge we yet have of the Parts of Plants) that theſe Juices move by a far different Contrivance of Parts from that of Animals; not yet here diſcovering any thing of Veins into one common Trunk, or Pulſation, no ſenſible ſtop by Ligature, no difference in Veins, *&c.* All which Difficulties, notwithſtanding, may, I hope, in time be happily overcome, and the Analogy betwixt Plants and Animals be in all things elſe, as well as in the Motion of their Juice, fully cleared.

There ſeem to be in Plants manifeſt Acts of Senſe: We inſtance in the ſudden ſhrinking of ſome Plants, the frequent cloſing and opening of Flowers, the critical erecting the Heads of Poppies from a pendulous Poſture, and particularly the Vermicular Motion of the Veins when expoſed to the Air. Again, the Veins of Plants may indeed be different, though at preſent we cannot tell wherein they are ſo; the Arteries within our Heads are hardly to be known by the Eye from the Veins. Further, there are natural and ſpontaneous Excretions or Ventings of ſuperfluous Moiſture in Plants, viſible and conſtant, in the *Crown Imperial*, *Ronella*, *Pinguicula*, &c. As to the Ligature, as it hath been hitherto applied by us, it is not to be relied on for the Diſcovery of this Motion; the Veins only of Plants being the Parts probably diſtendable.

Laſtly, We muſt either take that away from the other Reaſons given of the Neceſſity of the Circulation of the Blood of Animals, *viz.* The hindring of its breaking and clodding; or we muſt grant the ſame Motion to the venal Juice of Plants. We have undeniable Experiments to ſhew, That they both, when they are once drawn from their reſpective Veins, do forthwith break and coagulate; and that the *Serum* in the one, as well as in the other, becomes a ſtiff Jelly by a little ſtanding. And this Variety of Experiments hath taught us, that probably more uſeful Preparations, and certainly a truer *Analyſis* and Separation of the Parts of Vegetable Drugs may be effected, whilſt they are in bleeding and liquid, than after they are once become concrete, and have loſt their natural Fermentation.

By Dr. Willis, n. 95. p. 6060.

2. The Veins of Plants, which Mr. *Liſter* obſerves not to be ramified, but rather Bundles of them divaricated, repreſent the Nerves, which, (as Dr. *Willis* obſerved) go together in that which ſeems the common Trunk, like a Branch of Threads, which after ſeparate, and are variouſly divaricated: and theſe Nerves being cut, ſhrink up as the Veins of Plants, as much or more, than do the Veins or Arteries of Animals.

De Cerebo, c. 15. 19.

Dr. *Willis* obſerves alſo, that there are two ſorts of Nerves: One ariſing from the *Cerebrum*, ſubſervient to voluntary Motions, which properly belong to the Functions of Senſe; the other from the *Cerebellum*, ſubſervient to the involuntary Motions which chiefly belong to the Functions of Vegetation. And to theſe latter ſeem reducible thoſe Acts of Senſe, which Mr. *Liſter* ſpeaks of, in Plants.

The Nature and Difference of the Juices of Plants; By Dr Liſter, n. 224. p. 365.

LXIV. We obſerve that moſtly Juices of Plants coagulate, whether they be ſuch as are drawn from the Wounds of a Plant, or ſuch as do ſpontaneouſly exſudate: And yet that Exſudation ſeems to be often accidental too, that is, by a Cancer, or ſome other ſuch like Chance.

And yet I am uncertain what to think of the ſmall purple Blebs and Veins to be obſerved, more or leſs on all the *Hypericum* Kind, and on the Threads of the Flower, and the Hairs which cover the Leaves of *Rorella* in like manner. I doubt much, whether this may properly be called an exſudated and coagulated Juice, or no. Our Obſervations of thoſe of this Tribe, are what follow:

Purple Juices.

The ſmall green Leaves, next encompaſſing the yellow Flowers of *Androſæmum Hypericoides Ger.* are ſet with very ſmall round Blebs, full of a purple Juice; as are likewiſe, but with two or three only, the very Points or Tops of the yellowiſh Leaves themſelves: Yet the Stalk cut doth not to the Eye diſcover any ſuch diſtinct Veſſels, carrying that purple Liquor, which makes me ſuſpect it is ſeparated by Coagulation from the reſt of the Juice, and reſerved in thoſe ſmall Bags.

Hypericum Ger. The purple Juice yielding Blebs, in this Point are upon the Edging, on the outſides of all the Leaves. Alſo the Stalk, though round, hath a double Edge, on each Side one; and the Blebs or Bags, though but thinly, are yet obſervable on theſe very riſing Edges too of the Stalks. As for the yellow Flowers themſelves the outmoſt green Leaves, next and immediately encompaſſing them, have but few purple Stripes, but the yellow Leaves or Flowers, are edged with ſmall purple Bags on the one Side, and ſtriped with purple Juice yielding Veins on the other. Laſtly, On the very Tops of each Thread in the Flower, is one ſingle purple Bag.

Hypericum Aſcyron dictum, Caule quadrangulo J. B. In like manner all the Edges on the outſides of all the Leaves, from one End of the Stalk to the other of this Plant, are very thick ſet with purple Bags. Alſo in the Flower, all the Threads have one ſingle Bag on the Top; but the Flowers are yellow Leaves, and the green ones encompaſſing them, have very few purple Spots or Streaks viſible.

Hypericum pulchrum Tragi, J. B. Only the yellow Flower-Leaves, and thoſe green ones which next encompaſſes them, are thick edged with purple Blebs.

Diverſe Parts of the ſame Plant have diverſe Faculties, *V. C. P. A.* I add, that diverſe Parts of the ſame Plant, yield from the ſame Veins different coloured Juices, *v. g.* The Milk in the Root of *Spondylium Ger.* is of a Brimſtone Colour; but in the Stalk white.

Amongſt thoſe Juices that coagulate and are clammy, ſome there are which readily break with the Whey.

In the Middle of *July* I drew and gathered of the Milk of *Lactuca ſyl. coſta ſpinoſa, C. B.* which it freely and plentifully affords. It ſprings out of the Wound thick as Cream and ropes, and is white; and yet the Milk which came out of the Wounds, made towards the Top of the Plant, was plainly ſtreaked or mixed with a purple Juice, as though one had daſhed or ſprinkled Cream with a few Drops of Claret. And indeed the Skin of the Plant thereabouts was purpliſh alſo, perhaps with Veins. Again in the Shell I drew it; it turned ſtill yellower and thicker, and by and by curdled, that is, the white and thick caſeous Part did ſeparate from a thin purple Whey. So the Blood alſo of Animals, whilſt warm, remains liquid and alike: But ſo ſoon as cold it cakes, and has a *Serum*, or Whey, ſeparated from it. Alſo the caſeous part of the Milk of Animals is glutinous and ſtringy. Further, this *Serum* came freely from the other, by ſqueezing betwixt my Fingers; and the Curds I waſhed in Spring-water, which became immediately like Cags and tough (draw this Milk immediately, or let it fall off the Plant, into a Shell of fair Water, or other *Menſtruum*; as Vinegar, *S. V.* Spirit of Vitriol, or Sulphur, *&c.*) and remained ſtill white and dry. As for the purple Whey, after a Day's Inſolation, it ſtifned and became hard, and was eaſily formed into Cakes, which Cakes were yet very brittle, and would eaſily crumble into Powder. About *December* following I broke one of the Cakes made of the caſeous part of the Milk of this Plant; it then proved very brittle and ſhined, upon breaking, like Roſin: It was then of a dark-brown Colour: Moreover, it burned with a laſting Flame, like Roſin or Wax; and that being melted by Heat, it would draw out into long tough Strings like Birdlime. On the contrary, the purpliſh Powder, which was the Whey, if put into the Flame of a Candle, would ſcarce burn with a Flame at all, but ſoon be turned into a Coal. Laſtly, the purple Powder did taſte very bitter; whereas the caſeous Part was inſipid as Wax.

The Milk which the *Trachelium* kind plentifully yields, is very thick, and preſently curdles; the ſerous Part, or Whey, being of a brown Colour. Theſe

Juices ſmell ſour, ſomething like the Slices of green Apples, which have been long cut.

The thin Milk of *Tithymallus Helioſcopius Ger.* ſprings freely and plentifully; it is very clammy upon the Fingers; it is very white in drawing; it turns upon a Lancet, of a dark bluiſh; and indeed it is both of the Colour and Conſiſtence of blue ſkimmed Milk; made up with Wheat Flour into Cakes, it ſhews itſelf greaſy or oily, and ſcarce ever dries; it very hardly breaks or coagulates. I kept ſome of it pure and unmixed, in little Eſſence-Bottles, ſtopped lightly with Cork only; in theſe it broke in proceſs of time, and the Curds were eaſily to be formed into Cakes; which Cakes burned with a laſting Flame, and being melted drew forth into Strings like Wax; the Whey was clear like fair Water. This broken Milk in all my Bottles was very corrupt and ſtinking: But the Cakes I made up of this Juice, with Wheat Flour and a little Gum Arabick, dried well, and kept ſweet.

Other clammy Juices there are, which do not let go a Whey when they coagulate, but cake together.

Juices caking and not letting go their Whey.

I made Cakes of the ſole or unmixed Juice of *Sonchus lævis, & aſper*, without any Addition, and it parted not with any Whey.

Papaver Rheas Ger. bleeds freely a white Juice, and the Heads or Seed-Veſſels, when the Flower is gone, do yet bleed. I obſerved that in gathering it into Shells, it preſently turned its white Colour into a yellow one inclining to an Orange. At firſt ſpringing it roaped, or was but little clammy, and ſeemed to be very liquid and dilute; yet it did not part with any Whey, but grew ſtiff, and is very reſinous and oily.

Note, The Milks or Juices of Plants ſeem to be compounded, and mixed of Liquors of different and perhaps contrary Qualities; ſo that it is probable, if the caſeous part ſhall be Narcotick, for Example, the Whey may not be ſo or the one may be hurtful, and the other a good and uſeful Medicament.

Tragopogon flore luteo J. B. yields a Juice which, upon the firſt ſpringing from the Wound, is white and thick, but immediately turns yellow, and then redder and redder. It is of no unpleaſant Taſte; it is ſomething glutinous and oily, and parts not with much, if with any Whey, and therefore it is eaſily formed into Cakes alone.

Convolvulus major J. B. bleeds freely a white Juice, as I experienced in the middle of *Auguſt*; not only the Stalk and Leaves, but the white Flowers alſo in proportion bleed as plentifully as any part elſe. This Milk is very ſharp.

There is alſo a Juice of a Saffron Colour, which *Chelidonium majus Ger.* wounded freely affords. This Juice breaks not with a Whey, but is eaſily formed into Cakes, and ſtiffens in the Sun: It is thick, and of the conſiſtence of Cream, upon the ſpringing out of the Wound.

Saffron-coloured Juice.

There is another very clammy Juice, which is of a golden or yellow Colour, upon drawing; and this the Seed-Veſſels of *Centaurium luteum perfoliatum C. B.* in *July*, and after, even where the Seeds therein contained are turned black and ripe, yield plentifully and freely enough. (Theſe Juices, which the Heads, or Seed-Veſſels of Plants afford, may be thought of the ſame Nature with thoſe Juices which the Pulp of Fruits affords, the Pulps of Fruits and theſe exterior Veſſels being parts equivalent; (that is, Apples, for example, are nothing elſe but the Seed-Veſſels of their Kernels;) It is liquid upon the firſt drawing, and after a while it thickens, parting with no Whey; (*N. B.* I call this coagulating too) and this is of the Colour of Amber; it ſticks to one's Fingers, and pulls forth into Threads like Bird-lime; it would never become harder than very ſoft Wax, and that by being dried in the Shade only: for if ever ſo little be expoſed to the Heat of the Sun or Fire, it ſtraightway became exceeding ſoft. But as for the Cakes I made up of it and Wheat-flour, them I found in my Cabinet in Winter very hard and firm, and the unmixed Cakes ſtill ſoft. Theſe burn with an unpleaſant Smell; they emit a laſting Flame; they ſtill keep their Amber Colour, and draw out into Threads, in burning like Wax.

To this we may add the yellow Juice which the Wounds of *Angelica ſativa Park.* yield; it will not harden by Inſolation, or long keeping (for I have had an Eſſence-Bottle of it by me theſe two years) yet I perceive it ſtiffens, and will draw into Threads.

Gums. The next ſort of coagulate or clammy Juice we have taken notice of, are Gums; and ſome of them ſeem long to abide liquid, and perhaps inflammable; others there are which grow hard, and are not to be kindled into a Flame. They are eaſily to be diſſolved in Fountain-Water, (the Gum of Rhubarb and the Leaves, for example) and do ſparkle when put into a Flame: Which two Natures argue a ſerous or watriſh Part in them. Again, put into a Flame, they melt and become at it were liquid and ductile; which ſhews the caſeous Part in them. And becauſe they will not flame, it is an Argument of their Leanneſs, and Scarcity of Oil. All three put together plainly evince Gums to be coagulate Juices.

In *Auguſt* I have obſerved the Cluſters, both green and ripe, of *Periclymenum Ger.* very leaky; which upon nearer and heedful Inſpection I found to be a thin clammy Juice, or liquid Gum, which fell down upon the Leaves, and keeps its liquid Form there.

Here the purple Juice ſeems to be a Whey ſeparated from the liquid Gum: But I am of opinion it is a diſtinct Liquor.

Again the red Threads of *Rorella* end, or are topped, with little Bags; which being compreſſed do yield a purple Juice (as we above noted in the *Hypericum*) and thoſe ſmall Buttons on the very tops of thoſe Threads, are encompaſſed with ſmall tranſparent Pearls or Drops of a liquid Gum. They abide in this Form the hotteſt Summer's Day like Dew, whence alſo the Plant has its Name; and upon the leaſt Touch cleave to your Fingers, and draw out into long Threads like Bird-lime.

In like manner a liquid Gum (but that it ſtands not upon ſo long Threads, and is much thicker bedewed) you may obſerve upon *Pinguicula*. *Note well*, That the ſmall Dops and Threads, or Hairs, in either of theſe two Plants, are to be ſeen upon the uppermoſt or inmoſt ſide of the Leaf; and the utmoſt and undermoſt is ſmooth or void of them; which is ſomething contrary to all other Plants I have obſerved.

Methought I obſerved about the middle of *Auguſt*, the Chats of the Alder to be gummy. Perhaps it did exſudate from the Plant itſelf; as I gueſs the Honey-Fall, or gummy Dew to be obſerved upon the Leaves of the Oak, *&c.* are nothing elſe.

The *American*, or *Indian* Rhubarb, ſown in our Gardens, is the only Plant *Hard Gum.* that I have met with, or ever ſaw, which yielded a Gum; and yet becauſe it is of the very kind with our common Sorrels and *Lapatha*, I believe it not impoſſible, that even from our own Store, Herb-Gums might ſomeways or other be had. I ſay, that off the Stalk, or indeed off the Leaves of the *Indian* Rhubarb, I have gathered an Ounce at a time in *June*, of very white, clear, and hard Gum: In both thoſe Years I obſerved it to flower with us, as 1670, and in that Year it did not, 1669. It exſudates from all Parts of the Stalk and Ribs, on (*Note well*) the underſide of the Leaf itſelf. I gathered ſome in form of good big Drops, others as though the Stalk had been beſmeared with it, others ſhot into long and twiſted Wires, or Icicles. Moreover I obſerved, that the cankered Orifices or Places where the Gum had burſt forth, might be followed into the Stalk with a Knife, and that through the Skin, in certain Places, I could ſee that the Juice within the Plant was turned gummy, and looked clear like Ice.

It is the Experiment of Mr. *Fiſher*, that the clear and defecated Juices of *Cat. Pl. Aug. App. p. 315. 334.* moſt Plants have more or leſs Redneſs in them. Again, that the dried Root of *Acetoſa* (a Plant of the Family with Rhubard, which may well be called the *Indian* Sorrel, or ſour Docken) boiled, doth dye Water with a fair red Colour. And I have obſerved, that the unripe Seeds of Rhubarb yield a very fair and deep Purple, I mean the Husk of them. Conſider what hath been ſaid above of *Rorella*, and the *Hypericum* kind, concerning their Purple Juices yielding Blebs. *Note*, alſo here to this Purpoſe what we have ſet down above, Rhubarb, Sorrel, *&c*, do when they decay turn red.

The Juice extracted from the Roots of our *Engliſh* Rhubarb, by a Tincture of fair Water ſteam'd away, is nothing elſe but a lean uninflammable Gum; and tho' it differ in Colour, (perhaps from the yet woody Parts in it, as being of a deep Liver Colour) from the exſudating Gum, yet in other Natures, as this of being uninflammable, ductile in the Flame of a Candle, *&c.* it agrees with it. I may not omit, that the repeated Cuts I gave the Stalk, on purpoſe to have the Gum that way, failed my Expectation. This Gum is ſweet, or rather of no Taſte at all.

To this purpoſe I remember in Summer-time to have ſeen, even the Juice of Apples ſpontaneouſly gellied in *Languedoc*, and the Apples to look clear and hard like Ice, whence they call that ſort of Apple, *Pome Gellée*, or the frozen Apple: Tho' indeed, it be nothing elſe but the breaking or coagulating of the Juice in ſome Spots of it; for it is rare to ſee one of them all over ſo.

We may here give a probable Reaſon why a gentle Infuſion or Maceration of Rhubarb is a very ſure Purge, but the Subſtance or Powder of Rhubard, or a Decoction thereof, will have a quite contrary Effect, and bind. We may, I ſay, think that the ſharp and tart Juice in Rhubarb, wherein its purging Faculty lies, is by a gentle Infuſion ſo extracted, that it turns not to Gum in our Stomach; for I cannot think that the ſour Juice of Rhubarb is a ſpecifically diſtinct Liquor from the Gum, which I believe to be only an accidental Coagulation.

Green Plums, or Sloes, do often break forth with a Gum, which is clear and tranſparent; and it ſeems to haſten, if not ripen, at leaſt the red Colour. I have cut them, to the end that I might have gathered Gum in the Wounds: which indeed I did, but yet long after, when the Wounds ſeemed to be cankered, and that but in a ſmall Quantity to what they voluntarily ſpend.

Lauro-ceraſus, a beautiful Winter-green, which we have adopted to adorn our Court-Walls with, yields a clear Gum very plentifully; it is very white and very clear.

There are other ſorts of Juices, which will not of themſelves, that I have obſerved, exſudate out of the Wounds of their reſpective Plants.

Lime or ſtringy Juices.

I wrenched and wounded the Holly the latter End of *March*, and yet after ſome Days of warm and open Weather, I could not perceive the leaſt ſtirring of Juice: the latter End of *May* the Bark begins to be full of *Lime*, which you may try by preſſing a Piece of it betwixt your Fingers, and when you would take them off, the Juice or Lime draws out into Hairs, and follows your Fingers, cleaving to them like ſmall Threads.

Bird-lime Cat. Plant. Aug.

This *Lime* or Juice is ſeparated or taken out of the Bark thus: Peel off the Bark the Months of *May*, *June*, or *July*; for then it comes eaſily away, and moſt abounds with Juice: Boil the Bark in fair Water, until it be ſo tender, that the utmoſt thin grey Bark or Membrane, peel eaſily off; lay it ſo peeled, and cover it over with green Nettles or Fern, or ſuch like, *S. S. S.* in a Cellar for about ten Days, where it will ferment or rot, and become mouldy: Take them out and beat them well in a Mortar to a Paſte, and roll them up into ſmall Hand-balls, and in a running Spring waſh them clean from all the woody or ſticky Parts; which is effected by pulling and teaſing them. But *Note well*, that great Care is to be taken in the Waſhing of the Balls; for beſides that they muſt, if poſſible, be forthwith waſhed, the *Lime* will all get from you, except you ſo order the Matter, by engaging it with your Fingers, that it entangle. You would imagine, that upon breaking one of the Balls, that there was little or no *Lime* in them, ſo freely they moulder and crumble. After they once engage thoroughly, it will endure waſhing; and the clearer you take away the woody Parts, the better it is.

In cutting the tender Tops of Elder, the latter End of *May*, there will a ſtringy Juice follow your Knife, and draw out in Threads, ſomewhat like *Bird-lime*, or the Juice of Holly: It ſeems to be in certain Veins juſt within the Circle of Teeth or Wood.

Further, the diſſected Veins of many Plants afford us Oil, that is, ſuch a Juice, which being rubbed betwixt one's Fingers, is not at all clammy, but makes them greaſy and glib. Some of it ſtiffens not, as far as I have yet experienced; yet I believe it to be coagulate and mixed. *Oily Juices.*

We will inſtance in the Juice of *Helenium, ſive Enula Campana J. B.* You may take it off with a clean Knife, whereon its looks like Oil mixed with Water; that is, the thin or dilute Juice of the Plant, ſpringing up out of the Wound, together with the Oil. The like Experiment may be made upon *Cicuta.* The Juice of *Angelica ſativa Park.* I found altered after a Year's keeping, and grown very Limy.

Tapſus barbatus Ger. If you ſtrip off the Leaves in *June*, it ſeems to yield an oily Juice, but very much thinned with the watry one. It ſprings freely enough; it is of a dark green Colour, and I took it in Wheat-flour, and made it up in Cakes.

Alſo the Fruits of many Plants afford Oil, as *Oliva*, *Baccæ Lauri*, *Hederæ*, *Juniperi*, *Cornus Fœminæ*, &c.

The Pulp of moſt Seeds ſeem to abound with this oily Juice, and at ſometime before their Maturity it is liquid and viſible in them, in the form of a Milk.

Helleborus niger ſyl. adulterinus, etiam Hyeme virens J. B. The Seeds of this Plant, the latter End of *May*, are very milky, and by Inſolation are eaſily formed into Cakes, which are yet very oily, and being long kept, I have expoſed to the Flame of a Candle, which they received and burnt freely; ſparkling not very much, and not then neither being clammy at all. One thing I muſt not omit, that this Milk or Juice of the Seeds is of a very fiery and ſtinging Nature; for where I cut the Seeds out of the green Pods, they ſtruck my Eyes no otherwiſe than Onion is wont to do. Moreover, the Tops of my Fingers, which were wetted with this Juice, did boaken and ach; as when after extreme Cold one has the Hot-Ach in them; and that Pain continued in them for ſeveral Days; at length the Skin of my Finger's End peeled off.

Diacodium Album is a Medicament of the Seeds of *Poppy.*

There are other oily Juices, which after Coagulation harden and are called *Roſin*; and ſuch our Ivy yields abundantly. Hither alſo may be referred the Juice of *Juniperus vulgaris, baccis parvis purpureis J. B.* which is a hard fat Juice, and not much gummy. *Roſin.*

In the Chops of Ivy made in *March*, there did exſudate a thick Matter like Barm, yellowiſh and greaſy: It melted like Oil betwixt my Fingers, not having the leaſt Clammineſs then perceivable. In proceſs of time it hardened and cruſted on the Wounds like coarſe brown Sugar. It burns with a laſting Flame, and ſmells very ſtrong.

Alſo on the topmoſt Leaves of *Lactuca ſyl. Coſta ſpinoſa C. B.* In *July* many ſmall Drops or Pearls of an oily Juice, like coagulated and hardened Roſin, are plain to be diſcerned, eſpecially with a ſingle Microſcope: They are of an Amber Colour, and tranſparent; eaſily to be wiped off, as being an oily Juice exſudated. And I am of the Mind, that even the blue Flower of ripe Plums is nothing elſe but a fine reſinous Coagulation of the tranſudated Juice.

On the under-ſide of the Leaves, and all over the Stalk of ***Bonus Henricus* J. B.** do ſtick infinite ſmall tranſparent Pearls: Thoſe clear Drops are hard to the Touch, and feel like greaſy Sand; not clammy, and therefore it was well called unctuous by *C. B.* and we put this ſpontaneouſly exſudated Juice amongſt the reſinous Coagulations.

The Juices of Plants are alſo varied and diſtinguiſhed by Fermentation. And not only the Juices of Fruits are to be wrought, or ſet a working; as of the Apple, Pear, Briar, Grape, *&c.* as is well known: But there is an artificial Change, *viz.* Malting, to be made even in the Seeds of Plants, ſo as to make them ſpend freely, or let go their Juices, and communicate them to common Water, and receive a Ferment: Alſo the Juice of the Roots of *Clicyrrhiz* will ferment: Alſo the Juice of Cane, as Sugar. Again, the tapped Juices of Vegetables (wherein my Obſervations are limited) are ſuſceptible of a Ferment. As for Inſtance:

The 21ſt of *April* 1665, about eight in the Morning, I bored a Hole in the Body of a fair and large Birch, and put in a Cork, with a Quill in the middle: After a Moment or two it began to drop, but yet very ſoftly: Some three Hours after, I returned, and it had filled a Pint Glaſs, and then it dropped exceeding faſt, *viz.* every Pulſe a Drop. This Liquor is not unpleaſant to the Taſte, and not thick or troubled: Yet it looks as though ſome few Drops of Milk were ſpilt in a Baſon of Fountain-Water. There are many Ways of fermenting or ſetting this Juice a working, that is, of keeping it from coagulating.

The Maple, both that which is miſcalled the Sycamore, and the leſſer, bleed a fermentable Juice copiouſly, in the breaking up of hard Froſts.

Alſo the Willow, Walnut, Poplar, Wicking, are all ſaid to bleed in their Seaſons a vinous Juice.

To extract the Juice of Vegetables, as *Opium*, for Example, (as is uſual in the beſt Preparations and Methods of making *Laudanum*) with Spirit of Wine, is not probably to ſeparate any one part of that coagulate Juice from the other, as the ***Serum*** or Whey, for example, from the caſeous part of the Juice, but only to depurate or defecate the ***Opium***: For *S. V.* ſays Mr. ***Boyle***, will diſſolve ***Gum. Lac. Benzoin***, and the reſinous Parts of ***Jallap***, and even of ***Guiacum***, which are Cogulations and mixed Juices; and the ſame we may think of the Juices that are extracted by *S. V.* from other Herbs that are mixed.

Alſo thoſe other Ways of roaſting and drying Juices upon Plates over a gentle Fire, until they will rub to Powder, gives no great Satisfaction to me, that the ***Narcoſis*** of ***Opium***, for example, is gone or ſeparated, becauſe the dried Juice leſs offends the Noſe; that is, ſmells not ſo ſtrong.

The Whey of ***Lact. ſyl.*** will be only diſſolved in cold Water, the Curds wholly refuſing to mix with it: So that ſimple Water perhaps is the beſt ***Menſtruum***, and really ſeparates what *S. V.* only depurates.

Herbs of the ſame Make and Claſs, for the Generality have the like Virtue, by Mr. Ja. Petiver, *n.255.p.289.*

LXV. That Plants of the ſame Figure or Likeneſs, have for the generality much the ſame Virtues and Uſe, will not be thought an improbable Conjecture, if we conſider that the Organs and Structure of all Plants of the ſame Family, or Claſs, muſt have much the ſame Veſſels and *Ductus*'s to conſummate that regular Formation; and conſequently the Juices circulated and ſtrained thro' them, cannot be very heterogeneous; and that as for the moſt part the Scent and Taſte have great Affinity, ſo of courſe their Virtue likewiſe cannot be very diſſonant.

1. As for Inſtance, the Tribe of umbelliferous Herbs. It is the Property of theſe Herbs to have the Poſition of their Flower-branches to proceed from one Baſis, or Center, which expand themſelves into an Umbel, whoſe Flowers conſiſt of five irregular, or rather unequal, (that is, differing in ſhape and bigneſs) pentapetaloſe Leaves, from whence their Seed are produced, which are naked or double, or by their ſplitting ſeem ſo. This Genus I generally obſerve to be endowed with a carminative Taſte and Smell; they are powerful Expellers of Wind, and therefore are good in all flatulent Diſeaſes, and of great Uſe in the Cholic, *&c.* To inſtance a few, for Example, as Anniſe, Caraway, Cummin, Angelica, Smallage, Parſly, Lovage, *&c.* The greateſt Virtue of theſe Plants lies in the Seed, and next in the Roots, and in the Leaves of ſome few.

2. The *Plantæ Galeatæ* and *Verticillatæ* are a Family of Plants which bear their Flowers in Rundles or Whorles, at more or leſs Diſtances round the Stalk, whoſe monopetaloſe Flowers (if we may ſo call them, being ſuch at the Bottom) being tubuloſe, contrary to the laſt, are generally divided into five unequal Segments, as the Umbels; but with this Diſtinction, that the two greater *Petala*, or Flower Leaves in this Tribe, are ſometimes above, and other times below; whereas others are conſtantly the ſame; that is, always lie in the ſame Place, being expanded on a flat or plain Surface. The Flowers of our verticillated Plants, from the different Poſition of their *Petala*, are therefore diſtinguiſhed under the *Flores Galeatæ*, *ſeu Labiatæ.* The *Calyx*, or the Caſe to the lower or tubuloſe Part of each Flower, ſerves alſo for its Seed-Veſſel: In the Bottom of which is contained, in all I have yet obſerved, four Seeds ſet cloſe together upon a Plain, which Nature lets fall out when ripe, the Huſk being always open, and commonly divided into five Points, adequating the Segments of each Flower. The Sovereign Balm of theſe Herbs chiefly conſiſts in the Leaves and Huſks, rather than the Flowers. My Reaſon for giving this Preference to the Huſks of this Tribe, before the Flowers, contrary to all Authors, are, becauſe I commonly obſerve the *Calyces* are the chiefeſt, if not the only Part, on which I find its viſcous or ſulphureous Particles to adhere; this you may very eaſily perceive, not only by its much ſtronger and penetrating Smell, but by the clammineſs of this, far beyond the other Parts, as is very apparent; particularly in the Huſks of Sage and Clary. And if with Spirit of Wine you make a Diſtillation of theſe alone, you will find them much ſtronger than from a greater Quantity of Flowers only; which being of finer and more volatile Parts are only capable

of retaining what the Vicinity of the ſtronger and thicker Texture which the *Calyces* are compoſed of, and can without Prejudice eaſily communicate to them.

I look upon the generality of this Tribe, to be a Degree warmer, than the laſt; and their Heat conſequently to approach nearer to the *Aromata*, or Spices, than the Carminatives; and the Effects thereof to be more peculiarly appropriated to ſuch nervous Diſeaſes as are more intenſe, and the *Umbelliferæ* cannot ſo quickly reach, *viz.* Apoplexies, Epilepſies, Palſies, *&c.* in which Caſes our Lavender, Roſemary, Sage, *Stæchas*, and ſome others, are Simples, which all our antient Phyſicians, in theſe ſtubborn Diſeaſes, have very much applauded. And we ought not to forget Mint, Baulm, Penny-royal, Savory, Thyme, Hyſſop, Marjoram, Baſil, Origanum, Dittany of *Crete*, Marum or common Maſtick-Thyme, with *Marum Suriacum*, and ſome other.

3. We proceed next to thoſe Herbs which have a retrapetaloſe regular Flower; (by Regular, I mean, ſuch as have four equal *Petala* in each Flower.) Theſe, in relation to their Seed-Veſſels, are ſubdivided under two Heads, *viz. Siliquoſæ*, and *Capſulatæ*; being ſuch as have their Seeds contained in long or ſhort Receptacles, as Pods or Capſules. The moſt eſſential Virtue and Uſe of the Herbs of this Claſs, I obſerve are more particularly in the Leaves and Seed; and next them the Roots, and if any Parts are ſlighted, they are the Flowers and Pods.

The Leaves are more particularly uſed in the Water and Garden Creſſes, Sea and Garden Scurvy-graſs, Hedge-muſtard, *Iberis*, or *Sciatica* Creſſes, *Lepidium*, *Piperitis Officinarum*, *Cardamine*, *Burſa Paſtoris*, &c. To which may be added, our Cabbage, Coleworts, Savoys, Sprouts, *&c.* which are of this Tribe alſo.

Others of this Family that are more peculiarly eminent for the Virtue contained in their Seed, are the common Muſtard and Rape, the *Thlaſpi Dioſcorides* or Treacle-muſtard, the *Eruca* or Rocket, and *Sophia Chirurgorum* or Flixweed; the Seed of which laſt, I am informed, hath ſome Years paſt been uſed by ſeveral People in the North of *England*, for the Stone and Gravel, with very good Succeſs.

We come now to the Roots, two or three of which have gained no ſmall Reputation, as well in Diet as Phyſick, *viz.* the Radiſhes both Garden and *Spaniſh* (which is the large black-rooted) as alſo the Wild or Horſe-Radiſh; and to theſe the round and long-rooted Turnep mnſt be added.

Moſt of this Tribe I find, though they are very hot like the two laſt, *viz.* the *Umbelliferæ* and *Verticillatæ*, yet they exert their power in a much different manner, to wit, by a diuretick volatile Salt; and are found moſt prevalent and effectual in Chronick Diſeaſes; as the Scurvy, Dropſy, Gout, Jaundice and other ill Habits of the Body, where the Blood is vitiated, rather in its Particles than irregular Motion; carrying off its Impurity by diuretic *Diſcraſis*, or Diſcharge of the offending heterogeneous Salts therein contained; and conſequently by Purification, diſpoſing of it to a better, or more ſanative Diſpoſition.

The Separated Bark of a Tree reunited to the Tree, by Dr. Ch. Merret. *n.* 25. *p.* 453.

LXVI. In the midſt of *March*, *An.* 1664. I made a Section of the Rinds of Aſh; and of the Tree falſely called Sycamore. The firſt Section of each of the Rinds was ſquare, whereof three Sides were cut, the fourth uncut. The Succeſs was, that the whole Bark did unite, by binding it with Packthread, leaving a Scar in each of the Sides cut.

Then I cut off, and ſeparated entirely from the Tree, ſeveral Parts of the Bark, ſome ſhallower, leaving Part of the Bark on; others, to the very Wood itſelf; both in the Trunk and Branches, from an Inch-ſquare to leſs Dimenſions, and ſome of them I bound cloſe with Packthread, all which were ſeparated, a new Rind ſucceeding in their Place. Some I covered over, beyond the Place of Inciſion with a *Diachylon* Plaſter, and tied them faſt with Packthread. All which thus bound and plaſtered, did, within the Space of three Weeks, firmly unite to the Tree; not without ſome ſhrivelling of the outward Skin of the Bark, and alſo with ſome ſhrinking in each Side, where the Inciſion was made, where alſo appeared in each of the Interſtices a Scar. But tying the ſame about *Michaelmas*, and in the Winter Seaſon, at neither of theſe times any Union could be made of the Bark to the Tree; I ſuppoſe it was becauſe the Sap mounted not ſo vigorouſly, and in ſuch Plenty, as in the Spring Seaſon.

Some Branches of the forementioned Trees were decorticated round, and where no Union was, there certainly followed a withering of the Branch beyond the Place, where the Section was made.

I alſo ſeparated a Twig from the Branch, by cutting of it ſloping, for the better faſtening of it to the Branch again. This Twig I exactly fitted to the Branch from whence it was cut, in the ſame Poſture it before grew in. I firmly bound it, and covered it with *Diachylon* Plaſter. The Succeſs was, that in three Days time the Twig that was cut off withered.

Obſervations concerning the Barking of Trees, by S. Malpi. *n.* 161. *p.* 645.

LXVII. Wanting to find out the Motion of the nutritious Juice of Plants, I made a Trial upon ſeveral different Kinds of Trees, both by cutting the Bark, and tying it round, having firſt removed the annular Portion; and the upper Part of the Plant, *viz.* about the Section, conſtantly ſwelled, and increaſed in its Growth naturally, whereas the lower Part did not increaſe, and only ſometimes gave off Twigs. I tried the ſame Section on the lower Part of the Trunk, and in the Roots themſelves, and conſtantly the upper Part of the Trunk or Roots ſwelled conſiderably, and from this Part little Roots ſprouted out very plentifully, but the lower frequently decayed, and at laſt became rotten. This ſeems to confirm the Reflux of the nutritious Juice from the ſmalleſt Branches to the Extremities of the Roots; whence the Nouriſhment being intercepted, either by compreſſing, or cutting of the Veſſels, the remoter Parts of the Plants are deprived of their proper Nouriſhment, and a Swelling is produced by the refluent Juice; but it is propagated from the Leaves to the Extremities of the Roots. For which Reaſon your Floriſts having made a circular Inciſion in the Bark, lop off a ſmall Branch from the Parent Stock, and ſurround it with moiſt Earth, in which the new Branches ſpringing out above the Inciſion, begin to vegetate.

tate. For the nutritious Juice being puſhed or preſſed downwards, not only by ſtagnating, occaſions a Swelling near the Part where the Bark is cut; but burſting out, is abſumed in the Roots; whence the young Plant being nouriſhed of itſelf, at laſt is diſunited from the Parent Stock. Frequently enough in Roots upon the Brinks of Rivers, where the Part that has been lopped is expoſed to the open Air, from the Extremities of the Stump, ſpring up Twigs in Place of Roots, branching upwards.

Experiments of the barking of Trees, by Mr. Tho. Brotherton, n. 187. p. 306.

LXVIII. 1. *Anno* 1671. A Crab-Tree about 4 Inches in Diameter, was hacked round with a Hatchet, ſo as to cut pretty deep into the Wood; beſides the cutting off of the Bark, for about 4 Inches wide. After which it was the ſame Year obſerved to encreaſe above the ſaid hacking very conſiderably, and to ſhoot in length of Wood about one Foot. The next Year it increaſed conſiderably, and ſhot in length about 9 Inches; but the third Year it died to the very Root.

Much the like was obſerved in another, Part of whoſe Bark was eaten off by a Canker, that the lower Part ſtood without increaſing, and by degrees the Wood rotted and mortified; but the upper Part increaſed to the third Year, when it died alſo.

Fig. 174. A *Scots* Firr of three Years growth, having a Ring of the Bark cut off, of the breadth of 3 Inches, near the Bottom of the Stem or Stalk, below the uppermoſt Knot or Joint, was obſerved to grow and ſhoot out its Top about half a Yard, and the Parts all about the Ring to encreaſe very much in thickneſs; much more than it would have done, if the Section had not been made. But all that Part of the Stock between the ſaid Ring and the Knot next below it, increaſed not at all: But that Part which was below the next Knot, increaſed ſomewhat, yet not ſo much as if the ſaid Ring of the Bark had not been cut off. The ſecond Year it alſo increaſed conſiderably but not ſo much as the firſt, but the third Year it died.

A Branch of the Tree had a Ring cut off from it, *April* 1. 1686, and the Part above the Section increaſed, and grew till the 17th of *October* following, when it was cut off from the Tree. In this Space of time the Part below the Ring increaſed not at all, but ſtood at a ſtay; but the Parts about the Ring ſhot out a new Joint between a Foot and half a Yard, and increaſed in thickneſs for the whole length of it, and in all its Parts, twice as much as it would have done if it had not been cut, as was apparent by a like Branch on the oppoſite Side of the Knot, which was not cut nor barked round in the ſame manner; the Bark alſo of the Part above the Section ſwelled or grew downwards over the woody Part, which was bare, above half an Inch in breadth.

The uſual Time for making this Section was either in *March* or the beginning of *April.*

Trial was made upon ſome young Trees, cutting a Helical Swath of the Bark, about half an Inch in breadth, by leaving a little Helical Swath of Bark to communicate between the upper and under Part. In this Trial the Difference of Growth ſucceeded not, but the remaining Swath of the Bark ſwelled downwards, and by the End of the Year, covered the bared Part of the Wood.

The like Event almoſt followed upon making an indented Section round, of about half an Inch in breadth; the upper Bark quickly ſwelling downward, and joining again with the lower.

It was alſo obſervable, that as the upper Bark grew downwards, ſo it increaſed alſo in thickneſs, whereas the Bark below the Section thickned not at all.

A *Scots* Fir of three Years Growth, which ſhoots forth every Year both from the Body and the Branches a new Joint and circumambient Sprouts, to a determinate length, was barked with three Rings of about 1¼ Inch broad, each about the middle of the *Internodia* or Parts of the Stock between the Joints. In a Year, this Stock, which was about the bigneſs of a Quill, below the Ring to the next Joint, continued of the ſame bigneſs, but above the Ring it increaſed and grew to the bigneſs of one's Finger; and from the new Joint ſhot out new Limbs and Stock about a quarter of a Yard, which was ſomewhat bigger than if there had been no Ring made. The Branches increaſed likewiſe proportionably, by ſwelling in bigneſs, and from a new Joint ſhooting out new Body and Limbs, at the Top or Body. And the Body of the Tree below the Joint to the ſecond Ring, increaſed more than if the Ring had not been made: But the Part of the Stock below the Ring to the next Joint, increaſed not at all. The like ſhooting and increaſing was obſerved in the ſecond Limbs, Joint and Stock below it, between which and the loweſt Joint it increaſed not.

On one of the lowermoſt Branches of a young *Scot* Fir of two Years was made a Ring Section between the Body and firſt Knot of the Limb. The following Year, that Part of the Limb above the Ring increaſed twice or thrice as much as the correſponding Parts of the other Limbs from the ſame Knot, but the Part below the Section to the Body increaſed not at all.

A young Hazel was cut into the Body with a deep Gaſh, and the Parts of the Body above and below, cleft upwards and downwards, and the Splinters *a.* and *b.* by Wedges were kept off from touching each other, or the reſt of the Body. The following Year the Splinter above the Gaſh was grown very much, but the Splinter below ſtood at a ſtay, and grew not, but the reſt of the Body grew as if there had been no Gaſh made. *Fig.* 175.

Four young Poplar Trees, all of equal Bigneſs, Growth, Situation and Soil, as near as could be found, were thus ordered. The firſt had all its Branches and Top cut off; the ſecond had all its Branches pruned off, but it was left with a ſmall Head at the Top; the third had the Branches cut off half-way, and thoſe of the upper half left growing; the fourth was left growing without being at all pruned or lopped. In the following Years, the firſt ſhot out many Twigs round about, but the Body increaſed but little in height or bigneſs; the ſecond ſhot out likewiſe many Twigs where it had been pruned, and the Top Branches and Top alſo increaſed conſiderably, and the Body alſo increaſed much more in height and bigneſs than did the former; the third increaſed yet much more in all its Parts, than the ſecond; but the third increaſed in Limbs, Height, Bigneſs, moſt of all; ſwelling in

Bigneſs, and ſtretching in Height, and ſpreading in its Boughs, much more than the third; and in about ten Years, was more than four times as big as the firſt.

Of the Growth of Trees, Ib. 311. In the great Froſt, 1684, of twenty-five Poplars that had been pruned, nineteen were killed by it, and the remaining were very weak, and hardly able to recover, and increaſed very little in the following Years. Theſe Poplars were about 30 Foot high, and had only a ſmall Head left at the Top unlopped, of about 4 or 5 Foot, and were pruned the Spring before the great Froſt. Divers alſo of thoſe which had been pruned two Summers before the Froſt, were killed by it; but none of thoſe which had not been pruned at all, were hurt by it. And both in *Lancaſhire* and *Cheſhire*, Trees of 60 Foot in height, that had been pruned, and had only a ſmall Top left, were alſo killed by the ſaid Froſt, whereas thoſe Trees of the ſame kind and height, which ſtood near to them, but had not been pruned, continued to flouriſh, and ſuffer no Harm thereby. Several of thoſe Branches of about an Inch Diameter, and Trees, that had been barked round (as above) the Spring before the great Froſt, outlived the Violence of the ſame, and the preceding Winter.

Where theſe Prunings had been tried upon Trees 20 Foot high, the Difference of their Increaſe was ſenſible the following Summer; but in ſeven or eight Years time the Difference is prodigious; the unpruned Trees growing ſeveral times bigger than the pruned, both in Body and Branches.

When the Top-Branches would ſhoot out and grow 2 Foot, or more in length, the lower Branches would not ſhoot above 4 Inches; and in the Branches of the *Scotch* Fir, the Joints above the Rings barked round, would increaſe and grow much bigger, in three Years, than they would in five Years, if the ſaid Rings were not cut off.

A very large Pinaſter, about 2 Foot and a half in Diameter, and of a Height proportionable (*viz.* of about twenty Yards, the loweſt Boughs of which were about 30 Foot above the Ground) did ſpread and flouriſh on every Side alike, though it had no Root at all towards three Quarters of its Situation, but only toward one Quarter, into which it ſpread its Roots very far and large, divers of them reaching about 70 or 80 Foot from the Body of the Tree: The Reaſon of which ſpreading, was occaſioned by its being planted juſt within the ſquare Angle of the Corner of a deep, thick, and ſtrong Stone-Wall, which was as a kind of Banking or Wharfing againſt a River that ran by it.

Upon Conſideration of theſe, and divers other Obſervations and Experiments, I am of Opinion, 1. That the Sap (moſt of it, if not all) aſcends in the Veſſels of the lignous Part of the Tree, and not in the cortical Part, nor between the cortical and lignous Parts. 2. That the Increaſe and Growth of a Tree in Thickneſs is by the Deſcent of the Sap, and not by the Aſcent. And if there were no Deſcent, a Tree would increaſe but very little, if at all. 3. That there is a continual Circulation of the Sap, all the Summer Seaſon, and during ſuch time as the Sap is ſtirring, and not a Deſcent at *Michaelmas* only, as ſome have held.

By E. H. *ib.* p. 313. 2. To me it ſeems very probable, that the Bodies of Plants, as well as thoſe of moving Animals, are nouriſhed and increaſed by a double Food;

the one an impregnated Water, and the other an impregnated Air, and that without a convenient Supply of theſe two the Vegetable cannot ſubſiſt, at leaſt not increaſe. Theſe do mutually mix and coaleſce, and parts of the Air convert to Water, and parts of Water convert to Air. And as ſome of this latter are rarified and freed from their Chains, and become ſpiritual and airy, ſo others of the forementioned are clogged and fettered, and become debaſed. To this purpoſe all Plants as well as Animals, have a two-fold kind of Roots, one that branches and ſpreads into the Earth, and another that ſpreads and ſhoots into the Air: Both kinds of Roots ſerve to receive and carry their proper Nouriſhment to the Body of the Plant, and both ſerve alſo to convey and carry off the uſeleſs Recrements; uſeleſs, I mean, any further within the Body of the Plant, though uſeful to it when they are ſeparated, and without it; the one for ſeaſoning the Earth and Water wherein it is planted, and the other for ſeaſoning and preparing the Air.

The Communication of the Parts of the Tree with the Parts of the Fruit; by Dr. J. Beal, n. 48. p. 860. n. 46. p. 919. Vid. ſup. Sect. LX. 6.

LXIX. I had an excellent Summer Apple containing abundance of very pleaſing Juice; it was of that kind, which never grows large. The Body by the Burden of the Fruit always wreathed towards the Ground, the Branches were all curled and full of Knots at every turning, and theſe Branches are apt to grow, if a good Knot be ſet in the Ground, as ſoon as it is cut off, eſpecially about *Candlemaſs.* This Tree was hollow, and very near all the Timber extremely rotten, from the Top of the Stem to the Root, and every Sprig, how ſmall ſoever, appeared Cork-coloured and rotten at the Heart of the Timber. And ſo it was generally all over the Roots; and it is like it had been ſo many Years before; yet the Tree bore abundantly, with alternative Reſts every ſecond or third Year. The Fruit had ſcarce any Core; the Kernels were very ſmall, thin, and empty; nevertheleſs the Branches from the Knots grew well enough to repleniſh a Nurſery for me. This ſeems to intimate the Correſpondence between the pithy Part, Heart or Timber and the Seeds. And more to confirm this, a young Tree grew like a Sucker from the only ſound Root of the aforeſaid Apple-Tree. This Tree grew ſtraiter than others of the ſame kind uſually do; of which I conceive the Cauſe to be this, Suckers are commonly barren a pretty long time; and this continued barren till the Stem was ſtrong enough to bear the Fruit which loaded the Branches. But that which makes to our Purpoſe, is this: All the Fruit of this young Tree had full and ſound Kernels; and tho' it was the ſame Fruit, growing from the Root of the ſame Tree, yet it ſeemed not altogether ſo tender, delicious, and juicy, as the Fruit of the old Tree: nor yet was the Tree ſo fruitful. The Sap in the old Tree was leſs diverted, it ſeems to ſuſtain the Life of the Timber, which was now conſumed, and thereby was wholly appropriated for the Leaf, Bloſſom and the Pulp of the Fruit. For I do not undertake, that the Sap yields no Relief to ſuſtain the Life and Growth of the Timber ordinarily, and whilſt the Timber is entire: But I rather conceive, that there is a more immediate and peculiar relation between the Sap and pulpous Fruit, and the like between the Timber or whole Stock, and the Root of the Tree, to tranſmit the ſame Spirit and Nature to the Seed, of what Kind ſoever it be.

Some are of Opinion, that there paſſes into the Timber no Part of mere Earth to ſuſtain the Life and Growth of the Plant, but it only feeds on the ſucculent Part, aſcending by the Roots, and on the Air, and the Moiſture which the Dews of Heaven, the rainy Seaſons, and the Air afford. And if we conſider, that ſome lofty Trees grow upon the Rocks, where little or no Earth can be found; as alſo, how largely the Oak and Pear-Tree grows and ſpreads; and how many Years the one bears Acorns, the other Pears; ſometimes to the Quantity of yielding five or ſix Hogſheads Yearly (as I have known them do) and in Compariſon, how little Waſte of Earth about the Roots appears; we may find more Cauſe to attribute this large Expence of Materials to the perpetual Supply of Moiſture, than of much Earth. I will give you an Experiment, which may ſeem to determine the Point, though I yet ſuſpend my Judgment.

I took the largeſt *Kentiſh* Codlins, Pearmains, Pepins, and *Deuxans*; I withered them (which may be ſoon done many Ways), and then I cut them in the middle, quite through the midſt of the Kernels; Having carried them ſome Days in my Pocket, all that ſaw them took them to be very Wood, and they were indeed like very cloſe Cork: And ſome philoſophical Perſons (though I affirmed no Falſehood, but concealed the whole Matter) did upon the View, ſpread it abroad, that I had the Art of converting all Fruit into Wood; Pulp and Kernels and all was Wood. The ſame may be done upon Pears, Cucumbers, Turnips, and all the Grains and Vegetable Seeds, that are ſtuck in them, and are cheriſhed by a Supply of marly Water; thus I have had the Blades of Wheat and the Halme of Peaſe grow out of them to the length of a Foot: And then, by hanging it in a Cloſet, all becomes turned into Wood; and in ſome time after all is turned into Duſt and Earth. And as we are well taught by Mr. *Boyle*, that pure Liquids may be converted into Earth; ſo theſe terreſtrial Parts of the Fruit may be, from the Liquors thither collected, and derived from the Maſs of the Earth.

But to return to the clearing of the Affinities above claimed, I inſtance in Barberry-Roots, perforated by me, which bore Berries that had no Stones at all; and in hollowed Apple-Trees the Kernels will be very thin, and empty Skins, and uncapable of Growth. Gardeners tell me, that if you take the hard Stick out of the Root of Parſly, it will bear no kind of Seed. But it may be objected, that a very hollow Oak and an hollow Elm do bear pregnant Seed. I anſwer, That an Elm is all Timber to the Bark; and an Oak, when it is all putrid at the Heart, yet may have firm Wood enough to convey the Spirit of the Root into the Acorn; and the Roots may be ſound, when the Body of the Tree is much decayed by Rain beating in at the lopped Tops, or by other Paſſages thro' the Bark. We ſee that Beans, Wheat, and other Grains, grow kindly, if the Eye and Parts next adjoining be whole, tho' the Beans be full of great Holes in other Parts, or the main Body of the Wheat be cut off with Sciſſors. However, let the Objection give us the more Caution, that if we deſign to have Fruit without Stones, the Perforation be the bolder and the more compleat.

And to proceed further, ſome Trees are leſs fruitful, or altogether barren, by the exceſſive Growth or Firmneſs of the Timber: and theſe are recovered by croſs deep Hackings through the Bark, and ſuch Injuries done to the Timber, both in the Stem and main Roots; and they cleave the Roots, and put a Stone in the Cleft, that it may not cloſe again too haſtily. If this Violence be not done both to the Stem and Roots, the Remedy may fail. We ſee alſo, that Vines are leſs fruitful, when they are permitted to run out into many woody Branches.

To ſhew alſo the Proximity between the Sap of the Bark, and the Pulp of the Fruit. I did in the Summer-time make Reſts for Water on the Body of the *Kentiſh* Codlin-Trees, and cauſed Water to be frequently poured into thoſe Cavities. The Effect was this; The Apples grew to an extraordinary Bigneſs, and were very inſipid; and many of them had Parts in appearance much like the Pulp of Lemons. Some I ſuffered to hang on the Tree as long as they would, and thoſe became full of Spots of the Colour of Cork, or like the Rottenneſs of an Apple.

I omit the reſt, and haſten to redouble a Remark of the great Uſe which may be made of the chiefeſt Experiment. The Graft carries the Maſtery from the Stock for the Pulp of the Fruit; ſo that we have little hope of much change by mere Graftings, how oft ſoever reiterated. But if after many, and ſtrange, and choice Engraftings, you ſet the Kernel, Stone, or Seed of the grafted Fruit in a kind Mould, you may then expect ſome new or mingled kind of Plant, as Semi-Apricocks, *&c.* And thus the Almond and Peach may by many Changes in the Graftings, and by Inteneration of the Stones of the Peaches, and of the Shells of the Almond, and by Terebrations of the Stem and Root, here and there, alter their Guiſes, ſo that the Coat of the Almond may approach to the Pulp of the Peach; and the Kernel of a Peach be enlarged to a kind of Almond. And great ſtore of better Contrivances may from hence take riſe.

LXX. It is very difficult to determine whether Salt or Water be the nearer and more original Principle of all mixed Bodies; or the more copious, more active, or more influencing, in this or that Body. But this we have before our Eyes, that Birch and Alder feed more kindly on a thin uliginous Moiſture; the Elm, Pine, Firr, Pitch, and Cypreſs, chuſe a ſtronger Liquor: Yet theſe and many more of the wideſt Difference, are ſometimes ſeen to draw their whole Suſtenance, Bulk, and Ornaments, whether annual or perennial, from the Liquors they find in the ſame Piece of Ground, and from the ambient Air, and Dews; when as yet by our beſt Diligence we cannot diſtinguiſh the Liquors or Salts cloſely approaching their ſeveral Roots. And we may change all the Earth totally from the Roots of Trees, whoſe Barks, Sap, Fruit and Seed have very much differing Salts, and are of very different kinds; and yet ſee each Tree proſper the better by the exchange. Hence we may ſuſpect, that the very Contexture of their Bodies, from the firſt ſpurring of the Seed, and as they are formed gradually from the inviſible Principles or Spirit and Vigour of their Seeds, however ſmall and imperceptible, are the natural Alembicks, wherein the common Rain-Water and Air, are

Obſervations concerning Vegetation; By Dr. J. Beal. n. 56. p. 1131.

digeſted

digeſted into very much differing Leaves, Fruit, Seed, Roſins, Gums, cooling Juleps, &c. perhaps as the Cow's Belly converts the common Juice of all ſorts of Graſs into Milk; or as the Bee ferments the Dew of all Flowers into Honey and Wax.

We ſee alſo, that an handful of Moſs, ſometimes above a Span long, and reſembling Vegetables, grows out of a ſmall Oiſter-ſhell, without Earth, Dirt or Sand, for the Relief of the Root; Trees out of bare Rocks, and the annual Attire of Harts and Bucks, out of their bony Heads. Whence we may eaſily apprehend, how the Seeds in their Time, and afterwards the Roots, Stems, and Leaves of Trees, may be the proper Strainers to generate the peculiar Saps and Juices; and perhaps to ferment and boil the Liquors into their ſeveral Salts. It may paſs for a Reſemblance, if not for an Inſtance, that the Juice of ſome ſweet Pears may be dried into a very ſweet Sugar; and the Juice of ſome other Pears is ſo fierce, that at the opening the Rind with the Teeth, it doth almoſt ſuffocate, as if it would kill dead immediately; and yet this Juice by Time and ſeaſonable Maturation becomes ſweet, winy and luſcious. And we hear of divers Exotick Fruits that will kill outright, and that ſo quick as may challenge the fierceſt *Menſtruum* of an expert Chymiſt. Now as the Horns of a Stag have their whole Growth and Virtue from the protruding Blood and Spirits of the Animal, the Moſs, (as by the Microſcope appears when withered) from the inward Shell of the Oiſter and the marine Water: So in Plants, the Sap may by Heaters and Coolers, and other Changes in Summer, Autumn and Winter, by Winds and compreſſing Air, be hardened into Timber. Seeds and their Stones and Kernels. All ſeems to be but Sap at the firſt Draught, or little elſe beſides pure Air and Water, till theſe be concocted into peculiar Salts by more curious Strainers, and by more ſubtile Boilers than Art hath
Vid. ſup. §. LX. 1. hitherto deviſed. And this was my Aim in a former Paper, where by a ſlight and curſory Alluſion, I compared the Motion of Sap in Vegetables to the Deſcent of Liquors in an Alembick: I had no thought of ſquaring the Compariſon to agree in all Circumſtances; neither had I any Fancy, that the Sap in Winter deſcended to the Root, ſince I ſaw an Apple-Tree, that yielded four or five Hogſheads of ſtrong Cyder yearly, and a Pear-Tree that yielded more Perry; yet both growing on a dry Ground, where they could get no other Liquor than what the Clouds and the Air afforded. Yet I conceive, that theſe Trees have an Intercourſe of peculiar Spirits ſome way linked together, and vigorouſly co-operating, from the very Fibres of the loweſt Roots of the Top Leaves.

Some Thoughts and Experiments concerning Vegetation; by Dr. J. Woodward, n. 253. p. 193

LXXI. The Antients generally intituled the Earth to the Production of the Animals, Vegetables and other Bodies upon and about it: But ſeveral of the Moderns, and ſome of very great Name too, both here and abroad, have given their Vote in behalf of Water. My Lord *Bacon* is of Opinion, That *for Nouriſhment of Vegetables the Water is almoſt all in all, and that the Earth doth but keep the Plant upright, and ſave it from Over-heat and Over-cold.* Others there are who are ſtill more expreſs; and aſſert, Water to be the only Principle or Ingredient of all Natural Things. They ſuppoſe, that, by I cannot tell what Proceſs of Nature, Water is tranſmuted into Stones, into Plants, and, in brief, all other Subſtances whatever. *Helmont* particularly, and his Followers, are very poſitive in this; and offer ſome Experiments to render it credible; and Mr. *Boyle* diſcovers a great Propenſity to the ſame Thoughts and Opinion they had.

The Experiments they inſiſt upon are chiefly two: the firſt is, That Mint and ſeveral other Plants proſper and thrive very greatly in Water. The other is this: They take a certain Quantity of Earth, and bake it in an Oven; then they weigh it, and put it into an earthen Pot; having well watered this Earth, they make choice of ſome fit Plant, which being firſt carefully weighed, they ſet in it. There they let it grow, continuing to water it for ſome time, till it is much advanced in bigneſs. Then they take it up, and though the Bulk and Weight of the Plant be much greater than when firſt ſet, yet upon baking the Earth, and weighing it, as at firſt, they find it little or not at all diminiſhed in Weight; and therefore conclude, it is not the Earth, but Water that nouriſhes, and is turned into the Subſtance of the Plant.

I muſt confeſs, I cannot ſee how this Experiment can ever be made with the Nicety and Juſtneſs that is requiſite. However, nothing like what theſe Gentlemen would infer, can poſſibly be concluded from it; unleſs Water, which they ſo plentifully beſtow upon the Plant, in this Experiment, be pure, homogeneous, and not charged with any terreſtrial Mixture; for if it be, the Plant, after all, may owe its growth and increaſe intirely to that.

Some Waters indeed, are ſo very clear and tranſparent, that one would not eaſily ſuſpect any terreſtrial Matter were latent in them: Yet that is far ſhort of a Proof, that in reality there is none. For they may be highly ſaturated with ſuch Matter, though the Eye be not preſently able to deſcry or diſcern it. If pure and abſolutely refined Silver be perfectly diſſolved in Spirit of Nitre, or *Aqua fortis*, that is rectified and thoroughly fine, it does not darken the *Menſtruum*, or render it leſs pellucid than before.

But, after all, I never met with any Water, that however freſh, and newly taken out of the Spring, did not exhibit even to the naked Eye, great numbers of exceeding ſmall terreſtrial Particles, diſſeminated thro' all Parts of it. Thicker and craſſer Water exhibits them ſtill in greater Plenty.

Theſe are of two general Kinds. The one a vegetable terreſtrial Matter, conſiſting of very different Corpuſcles, ſome whereof are proper for the Formation and Increment of one ſort of Plant, and ſome of another; as alſo ſome of the Nouriſhment of one ſort of the ſame Plant, and ſome another. The other kind of Particles ſuſtained in Water, are of a mineral Nature: In ſome Springs we find common Salt, in others Vitriol, in others Alum, Nitre, Spar, Oaker, *&c.* Nay, frequently ſeveral of theſe, or other Minerals, all in the ſame Spring. All Water whatever is much charged with the vegetable Matter, this being fine, light, and eaſily moveable. As for the Mineral, the Water of Springs contains more of it, than that of Rivers, eſpecially when at a Diſtance from their Sources; and that of Rivers, more than the Water that falls in Rain.

If any one (who deſires further Satisfaction herein) put Water into a clear Glaſs Vial, ſtopping it cloſe to keep Duſt, and other exterior Matters out, and let it ſtand without ſtirring it, for ſome Days, he will then find a conſiderable Quantity of terreſtrial Matter in the Water, however pure and free it might appear when firſt put into the Vial. He will in a very ſhort time obſerve, as I have frequently done, the Corpuſcles, that were at firſt, while the Water was agitated and kept in Motion, ſeparate and hardly viſible, by Degrees as the Water permits by its becoming more ſtill and at reſt, aſſembling and combining together; by that Means forming ſomewhat larger and more conſpicuous *Moleculæ*. Afterwards he may behold theſe joining, and fixing to each other; by that Means forming large thin Maſſes, appearing like *Nubeculæ*, or Clouds in the Water, which grow more thick and opaque, by the continual appulſe and accretion of freſh Matter: If the ſaid Matter be chiefly of the Vegetable Kind, it will be ſuſtained in the Water, and diſcover at length a green Colour, becoming ſtill more of that Colour; I mean an higher and more ſaturate green, as the Matter thickens, and encreaſes. But if there be any conſiderable Quantity of mere Mineral Matter in the Water, this being of a greater ſpecifick Gravity than the Vegetable, as the Particles of it unite and combine in ſuch Number, till they form a *Moleculæ*, the *Impetus* of whoſe Gravity ſurpaſſes that of the Reſiſtance of the Water, ſubſides a great deal of it to the Bottom. Nor does it only fall down itſelf, but frequently intangling with the Vegetable *Nubeculæ*, forces them down along with it.

Upon the Whole, it is palpable and beyond reaſonable Conteſt, that Water contains in it a very conſiderable Quantity of terreſtrial Matter.

Now the Queſtion is, To which of theſe, the Water, or the earthy Matter ſuſtained in it, Vegetables owe their growth and increaſe.

For deciding of which, I conceive the following Experiments may afford ſome Light: And I can ſafely ſay, they were made with due Care and Exactneſs.

An. 1691, I choſe ſeveral Glaſs Vials, that were all, as near as poſſible, of the ſame Shape and Bigneſs. After I had put what Water I thought fit into every one of them, and taken an account of the Weight of it, I ſtrained and tied over the Orifice of each Vial, a Piece of Parchment, having an Hole in the Middle of it, large enough to admit the Stem of the Plant I deſigned to ſet in the Vial; without the confining or ſtraightning it ſo as to impede its Growth. My Intention in this was to prevent the encloſed Water from evaporating or aſcending by any other Way than only through the Plant that is to be ſet therein. Then I made choice of ſeveral Sprigs of Mint, and other Plants, that were, as near as I could poſſibly judge, alike, freſh, ſound, and lively. Having taken the Weight of each, I placed it in a Vial, ordered as above; and as the Plant imbibed, and drew off the Water, I took care to add more of the ſame from Time to Time; keeping an Account of the Weight of all I added. Each of the Glaſſes were, for better Diſtinction, and the more eaſy keeping a Regiſter of all Circumſtances, noted with a different Mark or Letter, *A*, *B*, *C*, &c. and all ſet in a Row, in the ſame Window, in ſuch manner that all might partake alike of Air, Light and Sun. Thus they continued from *July* 20th to *October* 5th, which was juſt ſeventy-ſeven Days. Then I took them out, weighed the Water in each Vial, and the Plant likewiſe, adding to its Weight that of all the Leaves that had fallen off, during the Time that it ſtood thus. And laſtly, I computed how much each Plant had gained; and how much Water was ſpent upon it. The Particulars are as follow:

Diſtinction of the Glaſſes.	*The ſeveral Sorts of Plants and Water.*	*Wt. of Plant when put in.*	*Wt. of Plant when taken out.*	*Weight gained in 77 Days.*	*Expence of Water.*	*The Proportion of the Encreaſe of the Plant to the Expen. of W.*
		gr.	*gr.*	*gr.*	*gr.*	
A.	Common *Spear-Mint* ſet in *Spring-Water.*	27	42	15	2558	1, *to* 170$\frac{8}{15}$
B.	Common *Spear-Mint*, *in Rain-Water.*	28$\frac{1}{4}$	45$\frac{3}{4}$	17$\frac{1}{2}$	3004	1, *to* 171$\frac{23}{35}$
C.	Common *Spear-Mint*, in *Thames-Water.*	28	54	26	2493	1, *to* 95$\frac{23}{26}$
D.	Common *Solanum*, or *Night-Shade*, in *Spring-Water.*	49	106	57	3708	1, *to* 65$\frac{3}{57}$
E.	*Lathyris, ſeu Cataputia Gerh.* in *Spring-Water.*	98	101$\frac{1}{2}$	3$\frac{1}{2}$	2501	1, *to* 714$\frac{4}{7}$

The common *Solanum* in the Vial *D*, had ſeveral Buds upon it when firſt ſet in the Water: Theſe in ſome Days became fair Flowers, which were at length ſucceeded by Berries.

Two other Vials *F.* and *G.* were filled, the former with Rain, the other with Spring-Water, at the ſame Time as thoſe above mentioned were; and ſtood as long as they did. But they had neither of them any Plant; my Deſign in theſe being only to inform myſelf, whether any Water exhaled out of the Glaſſes, otherwiſe than thorow the Bodies of the Plants. The Orifices of theſe two Glaſſes were covered with Parchment, each Piece of it being perforated with an Hole of the ſame Bigneſs with thoſe of the Vials above. In this I ſuſpended a Bit of Stick about the Thickneſs of the Stem of one of the aforeſaid Plants, but not reaching down to the Surface of the included Water: I put them in thus, that the Water in thoſe might not have more Scope to evaporate than that in the other Vials. Thus they ſtood the whole ſeventy-ſeven Days, in the ſame Window with the reſt; when upon Examination, I found none of the Water in theſe waſted or gone off; though I obſerved, both in theſe, and the reſt, eſpecially after hot Weather, ſmall Drops of Water, not unlike Dew, adhering to the inſides of the Glaſſes, that Part of them I mean that was above the Surface of the encloſed Water.

The Water in theſe two Glaſſes, that had no Plants in them, at the End of the Experiment, exhibited a larger Quantity of terreſtrial Matter, than that, in any of thoſe that had the Plants in them, did; the Sediment at the Bottom of the Vials was greater, and the *Nubeculæ* diffuſed through the Body of the Water thicker. And of that which was in the others, ſome of it proceeded from certain ſmall Leaves that had fallen from that Part of the Stems of the Plants that was within the Water, wherein they rotted and diſſolved.

The terreſtrial Matter in the Rain-Water, was finer than that in the Spring-Water.

An. 1692, I repeated the Experiment; the Plants were all Spear-Mint, the moſt kindly, freſh, ſprightly Shoots I could chuſe. The Vials were ſet in a Line in a South Window, where they ſtood from *June* 2, to *July* 28, which was juſt fifty-ſix Days.

Diſtinction of the Vials.	*The ſeveral Sorts of Waters.*	*Wt. of Plants when put in.*	*when taken out.*	*Weight gained in 56 Days.*	*Expence of Water.*	*Proportion of the growth of the Plant to the Expence of Water.*
		gr.	*gr.*	*gr.*	*gr.*	
H.	*Hyde-park Conduit Water.*	127	225	128	14190	1, *to* 110 $\frac{110}{128}$
I.	*Hyde-park Conduit Water.*	110	249	139	13140	1, *to* 94 $\frac{074}{139}$
K.	*Hyde-park Conduit Water, in which was diſſolv'd an Ounce and an half of common Garden Earth.*	76	244	168	10731	1, *to* 63 $\frac{147}{168}$
L.	*Hyde-park Water, with the ſame Quantity of Garden-Mould as in the former.*	92	376	284	14950	1, *to* 52 $\frac{182}{284}$
M.	*Hyde-park Water diſtilled off with a gentle Still.*	114	155	41	8803	1, *to* 214 $\frac{29}{41}$
N.	*Reſidue of the Water which remained in the Still after that in* M. *was diſtilled off.*	81	175	94	4344	1, *to* 46 $\frac{20}{94}$

The Plant which was ſet in *H.* was all along a very kindly Plant; and had run up to above two Foot in Height. It had ſhot but one conſiderable collateral Branch, but had ſent forth many and long Roots, from which ſprung very numerous, though ſmall and ſhort leſſer Fibres. Theſe leſſer Roots come out of the larger, on two oppoſite Sides, for the moſt part; ſo that each Root with its *Fibrillæ*, appeared not unlike a ſmall Feather; to theſe *Fibrillæ* adhered pretty much terreſtrial Matter. In the Water, which was at laſt thick and turbid, was a green Subſtance, reſembling a fine thin Conſerve.

The Plant in *I.* was as kindly as the former, but had ſhot no collateral Branches. Its Roots, the Water, and the green Subſtance, all much as in the former.

The Plant in *K.* though it had the Misfortune to be annoyed with many ſmall Inſects that happened to fix upon it, yet had ſhot very conſiderable collateral Branches; and at leaſt as many Roots, as either that in *H.* or *I.* which had a much greater Quantity of terreſtrial Matter adhering to the Extremities of them; the ſame green Subſtance here that was in the two preceding.

The Plant in *L.* was far more flouriſhing than any of the precedent, had ſeveral very conſiderable collateral Branches, and very numerous Roots; to which terreſtrial Matter adhered very copiouſly: The Earth in both theſe Glaſſes *K.* and *L.* was very ſenſibly and conſiderably waſted, and leſs than when firſt put in; the ſame ſort of green Subſtance here, as in thoſe above.

The Plant in *M.* was pretty kindly, and had two ſmall collateral Branches, and ſeveral Roots, though not ſo many as that in *H.* or *I.* but as much terreſtrial Matter adhering to them as thoſe had; the Water was pretty thick, having very numerous ſmall terreſtrial Particles ſwimming in it, and ſome Sediment at the Bottom of the Glaſs. This Glaſs had none of the green Matter above-mentioned in it.

The Water in *N.* was very turbid, and as high-coloured (reddiſh) as ordinary Beer: The Plant in it was very lively, and had ſent out ſix collateral Branches, and ſeveral Roots.

O. Hyde-Park Conduit Water, in which was diſſolved a Drachm of Nitre.

The Mint ſet in this, ſuddenly began to wither and decay; and died in a few Days. As likewiſe did two more Sprigs, that were ſet in it, ſucceſſively. In another Glaſs, I diſſolved an Ounce of good Garden Mould, and a Drachm of Nitre; and in a third, half an Ounce of Wood-Aſhes, and a Drachm of Nitre; but the Plants in theſe ſucceeded no better than in the former.

P. Hyde-Park Conduit Water. In this I fixed a Glaſs Tube, about 10 Inches long, the Bore about $\frac{1}{7}$ of an Inch in Diameter, filled with very fine and white Sand, which I kept from falling down out of the Tube into the Vial, by tying a thin Piece of Silk, over that End of the Tube that was downwards. Upon Immerſion of the lower End of it into the Water, this by little and little aſcended quite to the upper Orifice of the Tube. And yet in all the fifty-ſix Days which it ſtood thus, a very inconſiderable Quantity of Water had gone off, *viz.* ſcarcely 20 Grains, though the Sand continued moiſt up to the Top till the very laſt. The Water had imparted a green Tincture to the Sand, quite to the very Top of the Tube, and in the Vial it had precipitated a greeniſh Sediment mixed with black; to the Bottom and Side of the Tube, as far as it was immerſed in the Water, adhered pretty much of the green Subſtance deſcribed above.

Q. R. S. &c. Several Plants ſet in Vials, ordered in like manner as thoſe above, in *Oct.* and the following colder Months; theſe throve not near ſo much, nor did the Water aſcend in nigh the Quantity it did in the hotter Seaſons, in which the before recited Trials were made.

Some Reflections on the foregoing Experiments, ib. p. 207.

1. In Plants of the ſame Kind, the leſs they are in Bulk the ſmaller the Quantity of the fluid Maſs in which they are ſet, is drawn off; the *Diſpendium* of it, where the Maſs is of equal Thickneſs, being pretty nearly proportioned to the Bulk of the Plant. Thus that in the Glaſs, marked *A.* which weighed only 27 Grains, drew off but 2558 Grains of the Fluid: And that in *B.* which weighed only 28¼ took up but 3004 Grains, whereas that in *H.* which weighed 127 Grains, ſpent 14190 Grains of the liquid Maſs.

The Water ſeems to aſcend up the Veſſels of Plants in much the ſame manner as up a Filtre; and it is no great Wonder that a large Filtre ſhould draw off more Water than a leſſer; or that a Plant that has more or larger Veſſels ſhould take up a greater Share of the Fluid in which it is ſet, than one that has fewer and ſmaller ones can.

2. The much greateſt Part of the fluid Maſs that is thus drawn off, and conveyed into Plants, does not ſettle or abide there; but paſſes through the Pores of them, and exhales up into the Atmoſphere. That the Water, in theſe Experiments, aſcended only through the Veſſels of the Plants, is certain. The Glaſſes *F.* and *G.* that had no Plants in them, though diſpoſed of in like manner as the reſt, remained, at the End of the Experiment, as at firſt, and none of the Water was gone off; and that the greateſt Part of it flies off from the Plant into the Atmoſphere, is as certain. The leaſt Proportion of Water expended was to the augment of the Plant, as 46 or 50 to 1. And in ſome the Weight of the Water drawn off, was 100, 200, nay, in one above 700 times as much as the Plant had received of Addition.

This ſo continual an Emiſſion and Detachment of Water, in ſo great Plenty from the Parts of Plants, affords us a manifeſt Reaſon why Countries that abound with Trees and the larger Vegetables eſpecially, ſhould be very obnoxious to Damps, great Humidity in the Air, and more frequent Rains, than others that are more open and free. The great Moiſture in the Air was a mighty Inconvenience and Annoyance to thoſe who firſt ſettled in *America*; which at that Time was much overgrown with Woods and Groves: But as theſe were burnt and deſtroyed, to make Way for Habitation and

Culture of the Earth, the Air mended, and cleared up apace, changing into a Temper much more dry and ſerene than before.

Nor does this Humidity go off pure and alone, but uſually bears forth with it many Parts of the ſame Nature, with thoſe whereof the Plant, through which it paſſes, conſiſts. The craſſer indeed are not ſo eaſily born up into the Atmoſphere, but are uſually depoſited on the Surface of the Flowers, Leaves, and other Parts of the Plants: Hence comes our Manna's, our Honey's, and other gummous Exſudations of Vegetables. But the finer and lighter Parts are with greater Eaſe ſent up into the Atmoſphere; thence they are conveyed to our Organs of Smell, by the Air we draw in Reſpiration; and are pleaſant or offenſive, beneficent or injurious to us, according to the Nature of the Plants from whence they ariſe. And ſince theſe owe their Riſe to the Water that aſcends out of the Earth, through the Bodies of Plants, we cannot be far to ſeek for the Cauſe why they are the more numerous in the Air; and we find a greater Quantity of Odours exhaling from Vegetables, in warm, humid Seaſons, than in any others whatever.

3. A great Part of the terreſtrial Matter, which is mixed with the Water, aſcends up into the Plants as well as the Water. There was much more terreſtrial Matter at the End of the Experiment, in the Water of the Glaſſes *F.* and *G.* that had no Plants in them, than in thoſe that had Plants. The Garden-mould diſſolved in the Glaſſes, *K.* and *L.* was conſiderably diminiſhed and carried off. Nay, the terreſtrial and vegetable Matter was born up in the Tubes filled with Sand, Cotton, *&c.* in that Quantity as to be evident even to Senſe.

If I may be permitted to look abroad a while, towards our Shores and Parts within the Verge of the Sea, theſe will preſent us with a large Scene of Plants, that along with the Vegetables, take up into them mere mineral Matter alſo, in a great Abundance. Such are our Sea-purſlains, the ſeveral ſorts of Alga's, of Samphires and other marine Plants. Theſe contain common Sea-Salt, which is all one with the Foſſile, in ſuch Plenty, as not only to be plainly diſtinguiſhed on the Palate, but may be drawn forth of them in conſiderable Quantity.

How apt, and how much diſpoſed this vegetable Matter, being ſo very fine and light, is to attend Water in all its Motions, and follow it into each of its Receſſes, is manifeſt, not only from the Inſtances above alledged, but many others. Percolate it with all the Care imaginable, filter it with ever ſo many Filtrations, yet ſome terreſtrial Matter will remain; it is true, the Fluid will be thinner every time than other, and more diſengaged of the ſaid Matter; but never wholly free and clear.

I have filtred Water through ſeveral Sheets of thick Paper, and after that, through very cloſe fine Cloth, twelve times doubled; nay, I have done this over and over, and yet a conſiderable Quantity of this Matter diſcovered itſelf in the Water after all. It is true, filtring and diſtilling of Water intercepts, and makes it quit ſome of the earthy Matter it was before impregnated withal; but then that which continues with the Water after this, is fine and

light,

light, and ſuch conſequently, as in a peculiar manner fit for the growth, and nouriſhment of Vegetables. And this is the caſe of Rain-water; the quantity of terreſtrial Matter it bears upon the *Atmoſphere* is not great: But that which it does bear up, is mainly of that light kind of vegetable Matter, and that too perfectly diſſolved, and reduced to ſingle Corpuſcles, all fit to enter the Tubules and Veſſels of Plants. On which account 'tis, that this Water is ſo very fertile and prolifick. But the mineral Matter is, a great deal of it, not only groſs and ponderous, but ſcabrous and inflexible, and ſo not diſpoſed to enter the Pores of the Root. And a great many of the ſimple vegetable Particles by degrees unite and form, ſome of them, ſmall Clods or *Moleculæ*; ſuch as thoſe mentioned in *H*, *K* and *L*, ſticking to the Extremities of the Roots of thoſe Plants; others of them intangle in a looſer manner, and form the *Nubeculæ*, and green Bodies ſo commonly obſerved in ſtagnant Water. Theſe alſo when thus conjoined, are too big to enter the Pores, or aſcend up the Veſſels of Plants, which ſingly they might have done; they who are converſant in Agriculture will eaſily ſubſcribe to this. They are well aware, that be their Earth never ſo rich, ſo good, and ſo fit for the Production of Corn, or other Vegetables, little will come of it, unleſs the Parts be ſeparated and looſe. 'Tis on this account they beſtow the Pains they do in Culture of it, in digging, plowing, harrowing, and breaking of the clodded Lumps of Earth. 'Tis the ſame way that Sea-Salt, Nitre, and other Salts, promote Vegetation, they looſen the Earth, and ſeparate the concreted Parts of it, by that means fitting and diſpoſing them to be aſſumed by the Water: And carried up into the Seed or Plant, for its Formation and Augment. There's no Man but muſt obſerve, how apt all ſorts of Salts are to be wrought upon by Moiſture, how eaſily they liquate and run with it: And when theſe are drawn off, and have deſerted the Lumps, wherewith they are incorporated, thoſe muſt moulder immediately, and fall aſunder of courſe. The hardeſt Stone we meet with, if it happen, as frequently it does, to have any ſort of Salt intermixt with the Sand of which it conſiſts, upon being expoſed to humid Air, in a ſhort time diſſolves and crumbles all to pieces, and much more will clodded Earth or Clay, which is not of near ſo compact and ſolid a Conſtitution as Stone is. The ſame way likewiſe is Lime ſerviceable in this Affair: It is well known how apt it is to be put into Ferment and Commotion by Water, nor can ſuch Commotion ever happen, when Lime is mixed with Earth, however hard and clodded that may be, without opening and looſening of it.

4. *The Plant is more or leſs nouriſhed and augmented in proportion as the Water, in which it ſtands, contains a ſmaller or greater quantity of proper terreſtrial Matter in it.* The Truth of this Propoſition, is ſo eminently diſcernable through the whole Proceſs of theſe Trials, that I think no doubt can be made of it. The Mint in the Glaſs *C* was much of the ſame Bulk and Weight with thoſe in *A* and *B*. But the Water, in

which that was, being River-water, which was apparently ſtor'd more copiouſly with terreſtrial Matter than the Spring or Rain-water, wherein they ſtood, were, it had thriven to almoſt double the Bulk that either of them had; and with a leſs Expence of Water too. So likewiſe the Mint in *L.* in whoſe Water was diſſolved a ſmall Quantity of good Garden-Mould, though it had the Diſadvantage to be leſs when firſt ſet, than either of the Mints in *H.* or *I.* whoſe Water was the very ſame with this in *L.* but had none of that Earth mixed with it; yet in a ſhort time, the Plant not only overtook, but much outſtripped thoſe, and at the End of the Experiment, was very conſiderably bigger and heavier than either of them. In like manner, the Mint in *N*, though leſs at the beginning than that in *M.* being ſet in that thick, turbid, feculent Water, that remained behind, after that wherein *M* was placed, was ſtill'd off, had, in fine, more than doubled its original Weight and Bulk, and received above twice the additional Encreaſe than that in *M.* which ſtood in the thinner diſtill'd Water had done; and, which is not leſs conſiderable, had not drawn off half the Quantity of Water that had.

Why in the beginning of this Article, I limit the Proportion of the Augment of the Plant to the quantity of proper terreſtrial Matter in the Water, is, becauſe all, even the vegetable Matter, to ſay nothing of the mineral, is not proper for the Nouriſhment of every Plant. There may be, and doubtleſs are, ſome parts in different Species of Plants, that may be much alike, and ſo owe their Supply to the ſame common Matter: But 'tis plain, all cannot. And there are other parts ſo differing, that 'tis no ways credible they ſhould be formed all out of the ſame ſort of Corpuſcles. So far from it, that there want not good Indications, as we ſhall ſee by and by, that every kind of Vegetable requires a peculiar and ſpecifick Matter for its Formation and Nouriſhment. Yea, each Part of the ſame Vegetable does ſo, and there are very many and different Ingredients go to the Compoſition of the ſame individual Plant. If therefore the Soil, wherein any Vegetable or Seed is planted, contains all, or moſt of theſe Ingredients, and thoſe in due Quantity, 'twill grow and thrive there, otherwiſe 'twill not. If there be not as many ſorts of Corpuſcles as are requiſite for the Conſtitution of the main and more eſſential parts of the Plant, 'twill not proſper at all. If there be theſe, and not in a ſufficient Plenty, 'twill ſtarve, and never arrive to its natural Stature; or if there be any the leſs neceſſary and eſſential Corpuſcles wanting, there will be ſome failure in the Plant, 'twill be defective in Taſte, in Smell, in Colour, or ſome other way.

But though a Tract of Land may happen not to contain Matter proper for the Conſtitution of ſome one peculiar kind of Plant, yet it may for ſeveral others; and thoſe much differing among themſelves. The Vegetative Particles are commixt and blended in the Earth, with all the Diverſity and Variety, as well as all the Uncertainty conceiveable.

It is not poſſible to imagine how one, uniform, homogeneous Matter, having its Principles or original parts all of the ſame Subſtance, Conſtitution, on, Magnitude, Figure and Gravity, ſhould ever conſtitute Bodies ſo egregiouſly alike in all thoſe reſpects, as Vegetables of different kinds are; nay, even as the different Parts of the ſame Vegetable. That one ſhould carry a reſinous, another a milky, a third a yellow, a fourth a red Juice in its Veins; one afford a fragrant, another an offenſive Smell; one be ſweet to the Taſte, another bitter, acrid, acerb, auſtere, *&c.* that one ſhould be nouriſhing, another poiſonous, one purging, another aſtringent: in brief, that there ſhould be that vaſt difference in them, in their ſeveral Conſtitutions, Makes, Properties and Effects, and yet all ariſe from the very ſame ſort of Matter, would be very ſtrange.

The *Cataputia* in the Glaſs *E.* received but very little Increaſe; only 3½ *gr.* all the while it ſtood, tho' 2501 *gr.* of Water were ſpent upon it. I will not ſay the Reaſon was, becauſe the Water did not contain in it Matter fit and proper for the nouriſhment of that peculiar and remarkable Plant. No, it may be the Water was not a proper *Medium* for it to grow in; and we know there are very many Plants that will not thrive in it. Too much of that Liquor in ſome Plants may probably hurry the terreſtrial Matter thro' their Veſſels too faſt for them to arreſt and lay hold of it. Be that as it will, 'tis moſt certain there are peculiar Soils that ſuit peculiar Plants: In *England*, Cherries are obſerved to ſucceed beſt in *Kent*; Apples in *Herefordſhire*; Saffron in *Cambridgeſhire*; Woad in two or three of our Midland Counties; and Teazles in *Somerſetſhire*. This is an Obſervation that hath held in all parts of the World. But that Soil that is once proper and fit for the Production of ſome one ſort of Vegetables, does not ever continue to be ſo. No, in tract of time, it loſes that Property; but ſooner in ſome Lands, and later in others. If Wheat, for example, be ſown upon a Tract of Land, that is proper for that Grain, the firſt Crop will ſucceed very well, and perhaps the ſecond, and the third, as long as the Ground is in heart, as the Farmers ſpeak: But in a few Years 'twill produce no more, if ſowed with that Corn. Some other Grain indeed it may, as Barley; and after this has been ſown ſo often, that the Land can bring forth no more of the ſame, it may afterwards yield good Oats; and perhaps Peaſe after them. At length 'twill become barren, the vegetative Matter that at firſt it abounded withal, being educed forth of it, by thoſe ſucceſſive Crops, and *moſt* of it born off; each ſort of Grain taking forth that peculiar Matter that is proper for its own Nouriſhment.

After all which, that very Tract of Land may be brought to produce another Series of the ſame Vegetables; but never till it is ſupply'd with a new Fund of Matter, of like ſort with that it at firſt contained. This Supply is made ſeveral ways: By the Ground's lying fallow ſome time, till the Rain has poured down a freſh Stock upon it; or by the Tiller's Care in manuring it.

And for further Evidence that this Supply is, in reality, of like ſort, we need only reflect a while upon thoſe Manures that are found, by conſtant Experience, beſt to promote Vegetation, and the Fruitfulneſs of the

Earth; theſe are chiefly either Parts of Vegetables or Animals; which indeed either derive their own Nouriſhment immediately from vegetable Bodies, or from other Animals that do ſo. In particular, the Blood, Urine and Excrements of Animals, Shavings of Horns and of Hoofs, Hair, Wool, Feathers, calcined Shells, Lees of Wine, and of Beer; Aſhes of all ſorts of vegetable Bodies, Leaves, Straw, Roots, and Stubble, turned into the Earth by Plowing, or otherwiſe to rot and diſſolve there; theſe, I ſay, are our beſt Manures, and being vegetable Subſtances, when refunded back again into the Earth, ſerve for the Formation of other like Bodies.

We meet with ſtill further Confirmations of the ſame things in our Gardens. The Trees, Shrubs and Herbs, cultivated in theſe, after they have continued in one Station, till they have drived thence the greater Parts of the Matter fit for their Augment, will decay and degenerate, unleſs either freſh Earth, or ſome fit Manure be applied unto them. 'Tis true, they may maintain themſelves there for ſome time, by ſending forth Roots, further and further to a great Extent all round, to fetch in more remote Proviſion: But at laſt all will fail, and they muſt either have a freſh Supply brought to them, or they themſelves be removed and tranſplanted to ſome Place better furniſhed with matter for their Subſiſtence. And accordingly Gardiners obſerve, that Plants that have ſtood a great while in a Place have longer Roots than uſual; part of which they cut off when they tranſplant them to a freſh Soil, as now not of any further Uſe to them.

All theſe Inſtances, to paſs over a great many others that might be alledged, point forth a particular terreſtrial Matter, and not Water only for the Subject to which Plants owe their Increaſe. Were it Water only, there would be no need of Manures, or of tranſplanting them from Place to Place. The Rain falls in all Places alike, in this Field and in that indifferently; in one ſide of an Orchard, or Garden, as well as another; nor could there be any Reaſon, why a Tract of Land ſhould yield Wheat one Year, and not the next, ſince the Rain ſhowers down alike in each.

5. *Vegetables are not formed of Water, but of a certain peculiar terreſtrial Matter.* The Plant in *E* drew up into it 2501 gr. of the Fluid Maſs; and yet had received but 3 gr. and an half of Encreaſe from all that. The Mint in *L*. though it had at firſt the diſadvantage to be much leſs than that in *I*, yet being ſet in Water wherewith Earth was plentifully mixed, and that in *I* only in Water without any ſuch additional Earth, it had vaſtly outgrown the other, weighing at leaſt 145 gr. more than that did, and ſo having gained above twice as much as that had. In like manner, that in *K*, though it was a great deal leſs when put in than that in *I*, and alſo was impaired and offended by Inſects, yet being planted in Water wherein the Earth was diſſolv'd, whereas the Water in which *I* ſtood had none, it not only overtook, but conſiderably ſurpaſſed the other; weighing at leaſt 29 gr. more than that in *I*, and yet had not expended ſo much Water as that, by above 2400 gr. The Plant in *N*, though at firſt a great deal leſs than that in *M*, yet being ſet in the foul craſs Water, that was left in the Still, after that in which

M. was ſet was drawn off, in concluſion had gained in Weight above double what that in the finer and thinner Water had. The Proportion of the Augment of that Plant that throve moſt, was to the fluid Maſs ſpent upon it but as 1 to 46, in others it was as 1 to 60, 100, 200: nay in the *Catapuția* 'twas but as 1 to 714. The Mint in *B* took up 39 gr. of Water a Day, one Day with another, which was much more than the whole Weight of the Plant originally, and yet with all this it gained not one fourth of a Grain a Day in Weight. Thoſe that in *H* took up 253 gr. a Day of the Fluid, which was near twice as much as its original Weight, it weighing when firſt ſet in the Water but 127 gr. and after all, the daily Increaſe of the Plant was no more than $2\frac{2}{7}$ Grains.

6. Spring and Rain-Water contain pretty near an equal Charge of Vegetable Matter: River-Water more than either of them. The Plants in the Glaſſes *A*, *B* and *C*, were at firſt of much the ſame Size and Weight. At the End of the Experiment, the Mint in *A* had gained 15 gr. out of 2558 gr. of Spring-Water; that in *B* $17\frac{1}{2}$ gr. out of 3004 gr. of Rain-Water, but that in *C* had got 26 gr. out of only 2493 gr. of River-Water. So that theſe Proportions will hold for the Main: Yet I make no doubt, but the Water that falls in Rain at ſometimes, contains a greater Share of terreſtrial Matter, than that which falls at others. A more powerful and intenſe Heat muſt needs hurry up a larger Quantity of that Matter along with the humid Vapours that form Rain, than one more feeble and remiſs ever poſſibly can. The Water in one Spring may flow forth, with an higher Charge of this Matter, than that of another: This depending partly upon the Quickneſs of the Ebullition of the Water, and partly upon the quantity of that Matter, latent in the *Strata*, thro' which the Fluid paſſes, and the greater or leſs Laxity of thoſe *Strata*. For the ſame Reaſon, the Water of one River may abound with it more than that of another. Nay, the ſame River, when much agitated and in commotion, muſt bear up more of it, than when it moves with leſs Rapidity and Violence. That there is a great Quantity of this Matter in Rivers, and that it contributes vaſtly to the ordinary Fertility of the Earth, we have an illuſtrious Inſtance in the *Nile*, the *Ganges*, and other Rivers, that yearly over-flow the neighbouring Plains. Their Banks ſhew the faireſt and largeſt Crops of any in the whole World: They are even loaded with the Multitude of their Production, and thoſe who have not ſeen them, will hardly be induced to believe the mighty Returns thoſe Tracts made, in compariſon of others that have not the Benefit of like Inundations.

7. Water ſerves only for a Vehicle to the terreſtrial Matter, which forms Vegetables, and does not itſelf make any Addition unto them. Where the proper terreſtrial Matter is wanting, the Plant is not augmented tho' never ſo much Water aſcend into it. The *Catapuția* in *E* took up more Water than the Mint in *C.* and yet had grown but very little, having received only $3\frac{1}{2}$ gr. of additional Weight, whereas the other had received no leſs than 26 gr. The Mint in *I* was planted in the ſame ſort of Water as that in *K*

was; only the latter had Earth diſſolved in the Water, and yet that drew off 13140 gr. of the Water, gaining itſelf no more than 139 gr. in Weight; whereas the other took up but 10731 gr. of Water, and was augmented 168 gr. in Weight. Conſequently, that ſpent 2409 gr. more of the Water, than this in *K* did; and yet was not ſo much increaſed in Weight as this by 29 gr. The Mint in *M* ſtood in the very ſame Kind of Water as that in *N* did: But the Water in *M* having much leſs terreſtrial Matter in it, than that in *N* had, the Plant bore up 8803 gr. of it, gaining itſelf only 41 gr. the while: Whereas that in *N* drew off no more than 4344 gr. and yet was augmented 94 gr. ſo that it ſpent 4459 gr. of Water more than that did: And yet was not itſelf ſo much increaſed in Weight as that was, by 53 gr. This is both a very fair and a very concluſive Inſtance.

'Tis evident therefore, that Water is not the Matter that compoſes Vegetable Bodies; but 'tis the Agent that conveys that matter to them, that introduces, and diſtributes it to the ſeveral Parts for their Nouriſhment. That therefore there is that plentiful Proviſion and vaſt Abundance of it, ſupplied to all the Parts of the Earth, is a Mark of a natural Providence, ſuperintending over the Globe we inhabit.

This Fluid is capacitated for the Office here aſſigned it ſeveral Ways: By the Figure of its Parts; which, appears from many Experiments, is exactly and mathematically ſpherical; the Surfaces being perfectly polite, and without any of the leaſt Inequalities. It is evident, Corpuſcles of ſuch a Figure are eaſily ſuſceptible of Motion, yea, far above any others whatever, and conſequently the moſt capable of moving and conveying other Matter, that is not ſo active and voluble. Then the Intervals of Bodies of that Figure are, with reſpect to the Bulk, of all others the largeſt; and ſo the moſt fitted to receive and entertain foreign Matter in them. Beſides, as far as the Trials hitherto made inform us, the conſtituent Corpuſcles of Water are each, ſingly conſidered, abſolutely ſolid, and do not yield to the greateſt external Force. This ſecures their Figure againſt any Alteration and the Intervals of the Corpuſcles muſt be always alike. By the latter it will be ever diſpoſed to receive Matter into it; and by the former, when once received, to bear it on along with it. Water is further capacitated to be a Vehicle to this matter by the tenuity and fineneſs of the Corpuſcles of which it conſiſts. We hardly know any Fluid in all Nature, except Fire, whoſe conſtituent Parts are ſo exceeding ſubtile and ſmall as thoſe of Water are. They'll paſs Pores or Interſtices, that neither Air, nor any other Fluid will. This enables them to enter the fineſt Tubes and Veſſels of Plants, and to introduce the terreſtrial Matter, conveying it to all Parts of them; whilſt each, by means of Organs it is endowed with for the Purpoſe, intercepts and aſſumes into itſelf ſuch Particles as are ſuitable to its own Nature; letting the reſt paſs on thro' the common Ducts. Nay, we have, almoſt every where, mechanical Inſtances of much the ſame Tenor. 'Tis obvious to every one, how eaſily and ſuddenly Humidity, or the Corpuſcles of Water ſuſtained

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in the Air, pervade and inſinuate themſelves into Cords, however rightly twiſted, into Leather, Parchment, vegetable Bodies, Wood, and the like. This it is that fits them for Hygrometers, and to meaſure and determine the different Quantities of Moiſture in the Air, in different Places and Seaſons. How freely Water paſſes and carries with it terreſtrial Matter, thro' Filtres, Colatures, Diſtillations, *&c.* hath been intimated already.

8. Water is not capable of performing this Office to Plants, unleſs aſſiſted by a due Quantity of Heat: And this muſt concur, or Vegetation will not ſucceed. The Plants that were ſet in the Glaſſes, *Q. R. S. &c.* in *October* and the following colder Months, had not near the Quantity of Water ſent up into them, or ſo great an additional Encreaſe by much, as thoſe that were ſet in *June*, *July*, and the hotter. That the Concourſe of Heat in the Work is really neceſſary, appears, not only from the Experiments before us, but from all Nature; from our Fields and Foreſts, our Gardens and our Orchards. We ſee in *Autumn*, as the Sun's Power grows gradually leſs and leſs, ſo its Effects on Plants are remitted, and their Vegetation ſlackens by little and little. Its Failure is firſt diſcernable in Trees. Theſe are raiſed higheſt above the Earth, and require a more intenſe Heat to elevate the Water, charged with their Nouriſhment, to the Tops and Extremities of them; ſo that for want of freſh Support and Nutriment, they ſhed their Leaves, unleſs ſecured by a very firm and hardy Conſtitution indeed, as our Ever-greens are. Next the Shrubs part with theirs, and then the Herbs and lower Tribes: The Heat being at length not ſufficient to ſupply even theſe, tho' ſo near the Earth, the Fund of their Nouriſhment. As the Heat returns the ſucceeding Spring, they all recruit again, and are furniſhed with freſh Supplies and Verdure. But firſt, thoſe which are loweſt and neareſt the Earth, Herbs, and they that require a leſſer Degree of Heat to raiſe the Water with its earthy Charge into them, then the Shrubs and higher Vegetables, in their Turns, and laſtly the Trees. As the Heat increaſes, it grows too powerful, and hurries the Matter with too great Rapidity thro' the finer and more tender Plants. Theſe therefore go off and decay, and others that are more hardy and vigorous, and require a greater Share of Heat, ſucceed in their Order.

The ſame is obſervable in diſtant Climates; the hotter Countries yield ordinarily the largeſt and talleſt Trees, and thoſe too, in much greater Variety than the colder ever do; even thoſe Plants that are common to both, attain to a much greater Bulk in the *Southern* than in the *Northern Climes*; nay, there are ſome Regions ſo bleak and chill, that they raiſe no Vegetables at all, any conſiderable Size. This we learn from *Greenland*, from *Iceland*, and other Places of like cold Site and Condition. In theſe, no Tree ever appears, and the very Shrubs they afford are few, little, and low: Again, in the warmer Climates, and ſuch as do furniſh forth Trees, and the larger Vegetables, if there happen a Remiſſion and Diminution of the uſual Heat, their Productions will be impeded and diminiſhed in proportion. Our late colder Summers have given us Proof enough of this. For tho the Heat we have had was ſufficient, to raiſe the vegetative Matter in the lower Plants; into our Corn, our Wheat, Barley, Peaſe and the like; and we have had plenty of Strawberries, Raſberries, Currants, Gooſberries, and the Fruits of ſuch other Vegetables, as are low and near the Earth; yea, and a moderate Store of Cherries, Mulberries, Plumbs, Filberts, and ſome other that grow at a ſomewhat greater height: Yet our Apples, our Pears, Walnuts, and the Production of the taller Trees, have been fewer, and thoſe not ſo kindly, ſo thoroughly ripened, and brought to that Perfection, they were in the former more benign and warm Seaſons. Nay, even the lower Fruits and Grains have had ſome Share in the common Calamity; and fallen ſhort both number and goodneſs, of what the hotter and kinder Seaſons were wont to ſhew us. As to our Grapes, Apricocks, Peaches, Nectarins, and Figs, being tranſplanted hither out of hotter Climes, 'tis the leſs wonder we have of late had ſo general a failure of them.

Nor is it the Sun, or the ordinary Emiſſion of the ſubterranean Heat, only, that promotes Vegetation, but any other indifferently, according to its Power and Degree. This we are taught by our Stoves, hot Beds, and the like. All Heat is of like kind; and wherever is the ſame Cauſe, there will be conſtantly the ſame Effect.

There's a Procedure in every Part of Nature, that is perfectly regular and geometrical, if we can but find it out; and the further our Searches carry us, the more we ſhall have occaſion to admire this, and the better 'twill compenſate our Induſtry.

Ground fertilized by Froſt; By Dr. Beal. *n.* 56. *p.* 1140.

LXXII. I do often aſk Gardiners, and ſkilful Huſbandmen, whether all ſorts of Land are more fertilized, or more ſpeedily, by the ſolar Influence in our Climate, or by Froſts; and they generally anſwer, that Froſt and Snow make the quicker Diſpatch amongſt us, and the more general and richer Fertility.

Ground improved by Brine; By Dr. Jackſon. n. 54. p. 1079

LXXIII. All the Ground (at *Namptwich*) where Salt or Brine is ſpilt, is, when dug up, excellent Muck for Grazing-Ground; and even the Bricks that are thoroughly tinged with it, are very good Muck, and will diſſolve with other Muck, and fertilize Land conſiderably (eſpecially Grazing-Ground) for at leaſt four Years.

Improvements with Salt; By D. J. Beal. n. 55. p. 1135.

LXXIV. In the *Weſt* of *England*, ſome Huſbandmen make uſe of brackiſh Sand, and do find a good Reward when they be at the Charges of carrying it far, for the enriching of their Inheritances: Whilſt other Ruſticks will not be intreated to accept of the Brine they have in the midſt of their own Grounds. Certainly the ſaline Steams are carried by the Air and Wind much farther from Salt itſelf in Heaps or Veſſels, than from the Sea-water; from whence the Dews which ariſe in Vapours do deſcend as ſweet and pure as the Dew, which aſcends from the Earth; and the Rain ſhews no difference. And I give you once an experimental Proof, that either the ſaline Steams, which aſcend from a Heap of Salt, do pierce through very thick Sone Wall: Or, which I did much rather conceive, they generate more Salt, to the great depth of Thickneſs, in the Lime and Mortar of the Walls.

Improvements in Cornwall, *with Sea-Sand, by Dr.* Dan. Cox. *n.* 113 *p.* 293

LXXV. The Sea-ſand made uſe of in the Agriculture of *Cornwall*, is commonly at, or near the Sea-ſhore; which to diſtinguiſh from what is uſeleſs, know, that the Waſh of the Sea rolls and tumbles Stones, Shells, *&c.* one over another; whoſe grating makes this Sand. If the matter be ſhelfy (as we call it) that is, the grating of Stones, it is of ſmall value: But if it be notably ſhelly, then it is what we deſire. And of this ſhelly Sand are three Colours in our County; about *Plymouth*, and the Southern Coaſt, the Sand is bluiſh, or grey like Aſhes, which I conceive to be from the breaking of Muſcles chiefly and Oiſter-ſhells mixed with it. Weſtward, near the *Land's-End*, the Sand is very white, and in *Scilly* gliſtering: This, I think, comes from the mouldring of Moor-ſtones, as a kind of Free-ſtone mingled with very white Shells, ſuch as are called (when the Fiſh are preſerved) Scallops. On the North Sea about *Padſtow*, and Eaſtwards to *Lundy*, the Sand is rich, and of a brown-reddiſh-yellowiſh Colour, and is moſtly of the broken Shells of Cockles, which I gueſs to be of that Colour there, from the Waſh of *Severn*, which falls very dirty into the *Severn*-Sea; and perhaps that Accretion of the Shells may be tinged thereby. This we know, that tho' there be little or no Sea-Fiſh near the Mouth of the *Severn*, becauſe of the muddineſs thereof (and therefore Fiſh is carried to be ſold as far as from *Loo* on the South Sea to *Barnſtable* on the North) yet lower down in the North Sea, tho' there be not ſo much, yet that which is there is fatter and better than that which is taken in the South Sea.

Now beſides theſe Colours of Sands, there is alſo a difference in the bigneſs of the Grain, even in the ſame Harbour of *Plymouth*; in ſome Caves 'tis very ſmall, in others greater grained. 'Tis ſaid, that the ſmall is beſt for the Tenant, who only takes to Tillage for 4 Years, becauſe it works ſooner, and yields its ſpeedy return; the larger grained (they ſay) is better for the Landlord and the Land, becauſe it abides longer in the Ground, and makes the Paſture afterwards the better.

In *Falmouth*-Haven, near St. *Maw*'s Caſtle, there is a ſort of Sand, or rather Coralline, that lies a Foot under the Ouze; which Ouze being removed, and the Bed opened, this Sand is taken up by a Dredge, and is uſed about *Truro*, *Probus*, *&c.*

Vide Cap. III. Sec. LX.

Weſt of the Mount in *Pertcutbnoe*-Cave is a large ſhelly Sand. In *White-Sand-Bay*, and about St. *Ives*, it is very white and ſmall.

About *Minver*, *Perinſand*, and *Lelant*, the Sands are blown up by the Wind, and drown abundance of good Land, ſome Houſes, yea, and ſome Churches and Chapels are even buried with it; nor has any Art been hitherto thought of, to prevent its Devaſtation.

Now of all theſe Sands, the beſt are accounted, as to colour, firſt the reſtdiſh, next the blue, then the white; as to kinds, the moſt ſhelly, and the coralline are beſt, and that which is taken up from under the Salt-water, either by Dredges, or being left open by the ebbing of the Tide; the blown Sand is accounted of no uſe, and generally, if Sand be well drained of the Salt-water, ſo that it may be more conveniently carried, 'tis better than that which has lain long drying in the Sun and Wind, which takes off much of its Virtue.

Theſe uſeful Sands are carried by Lighters as far up into the Country, as the Tides will ſerve to that Purpoſe, and there they are caſt on ſhore, from whence they are fetched in ſome Places by Wheels, but in moſt (by reaſon of the hillineſs, and narrowneſs and badneſs of the Ways) on horſeback; one Horſe carrying about 13 or 14 Gallons. Seven or eight of theſe Horſes tailed together, are called a Train, which one Man drives to 9 or 10 Miles from the Sand-place; where each Seime, or Horſe-load with the Carriage, comes to about 8 *d.* or 9 *d.* in ſome Places, tho' not ſo much in others: For where it is dredged out of the Sea, it coſts 12 *s.* or 13 *s.* the Lighter, containing ſixſcore Seime, at the Landing-key, or Sand-place; but where 'tis loaded from the dry Beach after the Ebb, it is not above 4 *s.* the Lighter, and all this Charge of Lighterage is beſides the Land-Carriage. This Land-Carriage I have computed to amount, in the whole Country, to about 32000 *l. per An.*

When this Sand is brought home, it is ſpread on the Ground intended for Wheat; or uſually in the firſt Crop of four, whatever be the Grain; for after 4 Crops, 'tis our cuſtom to leave our Land to Paſture for 6 or 7 Years before we till it again. And indeed the Graſs will be ſo good immediately after Tillage, that we commonly mow it the firſt Year. This is called Mowing of *Gratten.*

The *Corniſh*-Acre is 160 Yards of 18 Foot to the Yard; in one of which Acres good Huſbands beſtow, according to the nearneſs or diſtance, near the Sand 300 Sacks (that is Horſe-ſeime or Burden;) where Men go three Turn a Day, about 200; where two Turn, 150; and where but one Turn, 80, or 100. And ſo proportionably in greater diſtance, even to 20 or 30 Sacks on an Acre, rather than none.

The Effect is uſually where much Sand is uſed, the Seed is much, and the Straw little. I have ſeen in ſuch a Place good Barley, where the Ear has been even equal in length with the Straw it grew on: But where leſs Sand is uſed, there is much Straw, and but little, and that hungry Grain.

After the Corn is off, the Graſs becomes moſtly a white Clovery, with ſome purple, if the Land be deeper. And this Graſs of well-ſanded Ground, tho' it be but ſhort, yet as to Feeding, giving good Creams, plenty of Milk, and all other good Purpoſes, it far exceeds the longer Graſs, where leſs Sand is uſed. Yea, Garden-Herbs and Fruit in thoſe Places are more, and thoſe better in their kind. In thoſe well-ſanded Places, alſo little or no Snow lies; there is a continual Winter-ſpring, an early Harveſt (a Month or ſix Weeks before what is within 6 or 7 Miles of the Place;) yea, ſuch a vaſt difference of the Air is ſound in ſo little a diſtance, that a Man may in an Afternoon travel, as it were, out of *Spain* into the *Orcbades*.

We have in this Country almoſt all kinds of Soil, and Sand agrees very well with each of them.

There is the ſame ſort of ſhelly Sand in moſt of the Coaſts of *England*, which lies wholly neglected. In the *Thames* about *Erith*, is taken up a ſort of Sand not much unlike *Plymouth*-Sand, made uſe of only by Brick-makers: But one of them told me, that by the ſides of his Sand-heap the Graſs did better ſpring than elſewhere, and turned to a Clover-Graſs.

'Tis well known that *Sandwich* Carrots and Peaſe are well eſteemed, and they grow there, where the Sea-Sand has a little over-blown and mixed with the Soil.

A ſandy Soil manured with Clay, by Dr. Liſter, n. 225. p. 413.

LXXVI. There are ſome Towns in the *North-Riding* of *Yorkſhire*, ſtanding upon a light ſandy Soil, *viz. Tolletborp*, *Tollerton*, &c. which do all of them manure much of their Ground by Clay. This Clay is dug hard by in the Declivity of a Hill. After having bared away two Yards deep of Sand, they ſink a ſquare Pit 6 Yards deep, and 8 or 10 Yards ſquare. The Clay is of a bluiſh brown Colour, not ſandy at all, but cloſe and fat, and very ponderous; it burns well for bricks. They lay 100 Load of Clay upon an Acre of Ground; they dig it at *Midſummer*, and only in a dry Summer. They obſerve, that for 3 or 4 Years it continues yet in Clods upon the Land, and that the firſt Year the Land ſo manured, bears rank, ill-coloured, and broad-grained Barley, but afterwards a plump round Corn like Wheat. This Clay manuring, will by certain Experience laſt 42 Years in the Ground, and that of *Tolletborp*, 48 Years: And then the Ground muſt be clayed again.

This ſandy Ground, unleſs clayed, will bear nothing but Rye, whatever other Manure or Lime your Compoſt be; but once clayed, it will bear Oats, Barley, Peaſe, &c.

*Improvements by Marling, by Mr.*Thomas Wright, n. 37. p. 725.

LXXVII. The greateſt Improvement of our Huſbandry in *Suffolk*, hath been by marling: For 50 Load of Marle to an Acre of dry, barren, lingy Heath, make (as they ſay) a very great Improvement both for Corn, Turneps, Clover-Graſs, Nonſuch, and Cole-ſeed. Of the 3 firſt, I ſuppoſe, I need to ſay nothing: But of the two laſt (which are late Experiments) I have received a very good Account from ſome *Norfolk* Gentlemen; one of whom, the laſt Year, had of 7 Acres of Nonſuch, or Hop-Clover, 70 Combs of Seed, beſides a great Crop of good Hay, which was twice as much worth as the beſt Crop of Wheat in this Country. 'Tis ſown (as the common Clover) with Corn, and when it once takes, it will hold 4 times as long in the Ground. About a Buſhel and an half ſoweth an Acre, and the Seed is now brought to 12 *s.* the Comb (or 4 Buſhels) which was lately at 40 *s.* The ſame Gentleman had the laſt Year 10 Combs *per* Acre of Cole-ſeed upon a very dry Heath, only improved by Marling.

Improving and draining the Bogs and Loughs in Ireland, by Mr. W. King. n. 170. p. 948.

LXXVIII. There are few Places in our Northern World, but have been famous for Bogs as well as *Ireland*; every barbarous ill-inhabited Country has them. I take the *Loca Paluſtria*, or *Paludes*, whither the ancient *Gauls Germans* and *Britons*, retired when beaten, to be the very ſame we call Bogs: And one ſhall find thoſe Places in *Italy* that were barbarous, ſuch as *Liguria*, were infeſted with them; and therefore I believe the true Cauſe of Bogs is want of Induſtry. There are many Bogs of late ſtanding in *Ireland*; when *O Donald* and *Tirone* came to the Relief of *Kingſale*, they waſted the Country, eſpecially as they came through *Connaught*, which by the means of the Earl of *Clanrickard* was generally loyal; and there is a great Tract of Ground, now a Bog, that was then plow'd Land; and there remains the Manſion-Houſe of my Lord ——— in the midſt of it.

Origin of Bogs.

But to ſhew how want of Induſtry cauſes Bogs, it muſt be remember'd, that the Springs (with which *Ireland* abounds) are generally dry, or near dry in the Summer-time, and the Graſs and Weeds grow thick about the Places where they burſt out: In the Winter they ſwell, and run, and ſoften, and looſen all the Earth about them. Now that Swerd or Scurf of the Earth that conſiſts of the Roots of Graſs, being lifted up and made fuzzy by the Water in the Winter (as I have at the Head of ſome Springs ſeen it lift up a Foot or two) is dried in the Spring, and doth not fall together. but whither in a Tuft, and new Graſs ſprings through it, which the next Winter is again lift up; and ſo the Spring is more and more ſtopt, and the Scurf grows thicker and thicker, till at firſt it make that which we call a Quaking Bog: And as it grows higher and drier, and the Graſs-Roots and other Vegetables become more putrid, together with the Mud and Slime of the Water, it acquires a Blackneſs, and grows into that which we call a Turf-Bog. I believe, when the Vegetables rot, the ſaline Particles are generally waſhed away with the Water, as being apt to be diluted in it; but the oily or ſulphureal are thoſe that chiefly remain, and ſwim on the Water: And this is that which gives Turf its Inflammability.

To make this appear, 'tis to be obſerved,

1. That in *Ireland* our higheſt Mountains are cover'd with Bogs, as well as the Plains; becauſe our Mountains abound more with Springs than can be imagined.

Now no body living on our Mountains, and no care being taken to clear the Springs, the whole Mountains are over-run with Bogs.

2. It is to be obſerved, that *Ireland* doth abound in Moſs, more than I believe, any other Kingdom.

Now this Moſs is of divers kinds, and that which grows in Bogs is remarkable; your light ſpungy Turf is nothing but a *Congeries* of the Threads of this Moſs, as I have frequently obſerved, before it be ſufficiently rotten, and then the Turf looks white, and is light: I have ſeen it in ſuch Quantities, and ſo tough that the Turf-Spades could not cut it; in the North of *Ireland* they call it *Old-wives Tow*, being not much unlike Flax. The Turf-holes in time grow up with it again; and all the little Gutters and Bogs are generally fill'd with it: And truly I chiefly impute the red or Turf-Bog to it; and from it even the hardened Turf, when broken, is ſtringy, though there plainly appear in it Parts of other Vegetables. And I am almoſt (from ſome Obſervations) tempted to believe, that the Seed of this Bog-Moſs, when it falls on dry and parched Ground, begets the Heath. However, the Moſs is ſo fuzzy and quick-growing a Vegetable, that it mightily ſtops the Springs; and contributes to thicken the Scurf, eſpecially in red Bogs, where only I remember to have obſerv'd it.

3. It is to be obſerv'd, that the bottom of Bogs is generally a kind of white Clay, or rather ſandy Marle; a little Water makes it exceeding ſoft, and when it is dry, it is all Duſt; ſo that the Roots of the Graſs do not ſtick faſt in it: But a little Wet looſens them, and the Water eaſily gets in between the Surface of the Earth and them, and lifts up the Surface, as a Dropſie does the Skin.

4. 'Tis to be obſerv'd, that Bogs are generally higher than the Land about them, and higheſt in the middle; the chief Springs that cauſe them being commonly about the middle, from whence they dilate themſelves by degrees. If you cut a deep Trench thro' a Bog, you will find the original Spring, and vaſt quantities of Water will run away, and the Bog ſubſide: The Bog at *Caſtle-Forbes* (as I was informed) ſubſided 30 Foot. I could hardly believe that; but found by Computation, that it could not be much leſs than half of it.

I muſt confeſs there are Quaking Bogs cauſed otherwiſe; when a Stream or Spring runs through a Flat, if the Paſſage be not tended, it fills with Weeds in Summer; Trees fall acroſs it and dam it up; then in Winter the Water ſtagnates farther and farther every Year, till the whole Flat is cover'd. Then there grows up a coarſe kind of Graſs peculiar to theſe Bogs; this Graſs grows in Tufts, and their Roots conſolidate together, and yearly grow higher, inſomuch that I have ſeen them to the height of a Man.

This Graſs rots in Winter, and falls on the Tufts and the Seed with it, which ſprings up next Year; and ſo ſtill makes an Addition. Sometimes the tops of Flags and Graſs are interwoven on the Surface of the Water, and this becomes by degrees thicker, till it lie like a Cover on the Water; then Herbs take Root in, and by a *Plexus* of the Roots it becomes very ſtrong, ſo as to bear a Man. I have gone on Bogs that would riſe before and behind, and ſink where I ſtood to a conſiderable depth, under which was clear Water.

Inconveniences of Bogs.

The Inconveniences of theſe Bogs is very great.

1. A conſiderable part of the Kingdom is render'd uſeleſs by them; they keep People at a diſtance from one another, and conſequently hinder them in their Affairs, and weaken them; for it is certain, that if we ſuppoſe a thouſand Men live on Four contiguous Acres, they can both better aſſiſt and defend one another, than if they liv'd on Four not contiguous.

2. The Land which generally ſhould be our Meadows, and fineſt eveneſt Plains, are covered with Bogs. This I obſerv'd through all *Connaught*, but more eſpecially in *Longford*, and likewiſe at *Weſt Meath*, and in the North of *Ireland*.

3. The Bogs are a great deſtruction to Cattle, the chief Commodity of *Ireland*. In the Spring-time, when the Cattle are weak and hungry, the Edges of the Bogs have commonly Graſs; and the Cattle venturing in to get it, fall into Pits or Sloughs, and are either drowned, or (if they are found) ſpoilt in the pulling out.

4. They are a Shelter and Refuge to Tories and Thieves, who can hardly live without them.

5. The Fogs and Vapours that riſe from them are commonly putrid, ſtinking, and very unwholeſome: For the Rain that falls on them will not ſink into them, there being hardly any Subſtance of its Softneſs, more impenetrable by Water than Turf; and therefore Rain-water ſtands on them, and in their Pits; it corrupts there, and is all exhaled by the Sun, very little of it running away, which muſt of neceſſity affect the Air.

6. They corrupt our Water, both as to its Colour and Taſte: For the Colour of the Water that ſtands in the Pits, or lies on the Surface of the Bog, is tinctur'd by the reddiſh black Colour of the Turf; and when a Shower comes that makes theſe Pits to overflow, the Water that runs over tinctures all it meets, and gives both its Colour and Stink to a great many of our Rivers.

Advantages.

1. The Natives nevertheleſs had heretofore ſome Advantage by the Woods and Bogs. By them they were preſerved from the Conqueſt of the *Engliſh*, and I believe it is a little Remembrance of this that makes them ſtill build near Bogs. It was an Advantage then to them to have their Country unpaſſable, and the fewer Strangers came near them, they liv'd the eaſier, for they had no Inns; every Houſe where you came was your Inn, and you ſaid no more, but put off your Broges, and ſet down by the Fire.

2. They are alſo now of ſome uſe to us; for moſt of *Ireland* have their Firing from them: Turf is accounted a tolerable ſweet Fire; and we having very impoliticklẏ deſtroy'd our Wood, and not as yet found Stone-Coal, ſave in few Places, we could hardly live without ſome Bogs. I have ſeen Turf chark'd, and then it ſerves to work Iron, and, as I have been inform'd, will ſerve to make it in a Bloomery or Iron-work. Turf chark'd I reckon the ſweeteſt and wholſomeſt Fire that can be, fitter for a Chamber and conſumptive People, than either Wood, Stone-Coal or Charcoal.

3. A Turf-Bog preſerves things ſtrangely; a Corps will lie entire in one for ſeveral Years. I have ſeen a Piece of Leather pretty freſh, dug out of a Turf-Bog, that never in the Memory of Man had been dug before. Butter has been found, that had lain above 20 Years: And though not fit to be eaten, yet it ſerv'd well enough to greaſe Wool.

Trees are found intire in them, and thoſe Birch or Alder, that are very ſubject to rot. The Trees are ſuppos'd by the ignorant Vulgar to have lain there ever ſince the Flood; but the Truth is, they fell on the Surface of the Earth, and the Bog, as is ſhewed above, ſwelling by degrees, at laſt covered them; and being of an oily vegetable Subſtance, it, like a Balſam, preſerves them. Theſe Trees burn very well, and ſerve for Torches in the Night. I have ſeen of the Trees half ſunk into the Bogs, and not quite covered.

The inconveniencies remedy'd by dreining.

All the Inconveniencies of our Bogs may be remedy'd, and they may be made uſeful to us by dreining; for I never obſerv'd one Bog without a Fall ſufficient to drein it, nor do I believe there is any. But the great and weighty Objection againſt this Improvement is the Charge; an Acre of good Land in moſt parts of *Ireland*, is about 4 *s. per Annum*, and the Purchaſe 14 or 15 Years; and therefore 3 *l.* will purchaſe an Acre of good Land, and it is very doubtful with moſt, whether that Sum will reduce a Bog. This reaſoning paſſes current, and is the great Obſtacle and Impediment of this Work; but if theſe things following were done, and conſidered, I very believe it would be removed.

1. An Act of Parliament ſhould be made, that who did not at ſuch a time make ſome progreſs in dreining their Bogs, ſhould part with them to others that would, and allow a Paſſage to them thro' their Lands.

2. 'Tis to be conſider'd, that in Quaking Bogs one Trench dreins many Acres: And when dry, it is generally Meadow, or the beſt grazing Ground.

3. Every Bog has about it, a deep, marſhy, ſloughy Ground, which they call the Bounds of a Bog. One deep Trench round the Bog keeps out the Cattle, and turns the Bounds into good Meadow.

4. I remember a red Bog of 60 Acres, which a Gentleman reduc'd to good grazing Ground, worth 3 *s.* an Acre, for 25 *l.* which is leſs than three Years Purchaſe.

5. Gentlemen ought to conſider, that what they lay out this way, goeth by degrees, and they are not ſenſible of it; it goeth among the Tenants, and enables them to pay their Rent the better: 'Tis a Work of Charity, and employs Hands, and conduces to both the Ornament and general Profit of the Kingdom.

6. To make the red Bogs fit for grazing, theſe Rules may be obſerv'd.

1. A deep Trench muſt be made round the Bog. This not only reduces the Bounds of the Bog, as before, but goes a great way to dry the Bog itſelf. It ſerves likewiſe as a common Sink, into which all your Dreins vent themſelves.

2. Obſerve which way the little Sloughs run in the Bog, and be ſure to cut your Dreins a-croſs them.

3. The firſt Dreins on the Bog ought not be above 2 or 3 Foot deep or wide; for the Bog is ſo ſoft, that deep Trenches will not ſtand, but fill up again. When the Surface of the Bog is cut in little Trenches, ſuppoſe

at 20, 30, 40 Perch diſtance, it will be ſo dry'd, that Cattle may graze on it all Summer.

4. A Year or two after the little Trenches are made, and the Bog a little dry, they are to be made 6 Foot wide, and as deep as the ſoftneſs of the Bog will permit. And this will certainly make the Bog uſeful for grazing. A Year or two after this you may attempt to cut one or two of the Trenches to the bottom of the Bog; for till that be done, I do not reckon the Bog ſecured.

5. A Gentleman ought to oblige all his Tenants to cut their Turf in theſe Trenches, and likewiſe to cut his own ſo.

6. Where a Bog is pitted, he is to cut a Paſſage from one Pit to the next for the Water, and ſo make a Communication to the common Drein; and if his Pits be once dry'd, there will grow Graſs or Heath at the bottom, fit for grazing, and they will be a Shelter for Cattle in Storms.

7. When his Bog is dry'd, it is thereby made better Turf; and then he is to ſet out a part of it for that uſe, and to oblige them to cut it clear away: And the Bog being remov'd, the bottom will make a good Meadow.

8. He may cut off the Surface of the Bog, and burn it; or elſe bring Earth, and lay on it. Sanding, or rather Gravelling, is a great Improvement in this Country; the Land ſo manur'd will bring Corn 12 or 14 Years. They ſay, Gravelling is bad for Graſs; but the contrary is apparent, eſpecially in Bogs. I have obſerv'd by the Way-ſide, where the Ways paſs thro' Bogs, if a little Earth had fallen on the Bog, as ſometimes there doth fall a little of that which they bring to mend the High-way, it has turned the Bog into a green Sod, with a very fine Scutch Graſs on it: And I doubt not but the ſame Charge, that ſands or gravels Land, would reduce a dry'd Bog even to be arable.

Improvements of Loughs.

The natural Improvements of *Loughs* or *Lakes*, is firſt to drein them as low as we can, and then to turn the reſidue of the Water into Fiſh-Ponds: By planting a few Trees about them, and ordering them thus, they may be made both uſeful and ornamental.

And Turloughs.

As to thoſe Places we call *Turloughs*, *quaſi Terreni Lacus*, or *Land-Lakes*, they anſwer the Name very well, being Lakes one part of the Year of conſiderable depth, and very ſmooth Fields the reſt. There are in theſe Lakes Holes, out of which the Water riſeth in Winter, and goeth away towards Summer, many hundred Acres being drowned by them, and thoſe the moſt pleaſant and profitable Land in the Country. The Soil is commonly a Marle, which by its ſtiffneſs hinders the Water from turning it into a Bog; and immediately when the Water is gone, it hardens ſo that you ride thro' an even graſſy Field. Theſe, if they could be dreined, would be fit for any uſe, would make Meadow, or bear any Grain, but eſpecially Rape, which is very profitable. They are chiefly in *Connaught*; and their Cauſe is obvious enough: It is a ſtony hilly Country, and the Hills have Cavities in them through which the Water paſſes; it is common to have

Vide ſuprà Cap. II. Sect. XIX.

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a Rivulet ſink on one Side of a Hill, and riſe a Mile or half a Mile from the Place. The Brooks are generally dry in Summer; the Water that ſhould be in them, ſinking between the Rocks, and running under Ground; inſomuch as that in ſome Places where they are overflowed in Winter, they are forced in Summer to ſend their Cattle many Miles for Water. There is one Place on a Hill near *Tuam*, between two of theſe *Turloughs*, where there is a Hole, the Superſtitious People call the *Devil's Mill*, and make Fables concerning it: If you ſtand by this Place, you will hear a great Noiſe like that of Water under a Bridge. When there is a Flood in Winter, one of the *Turloughs* overflows, and vents itſelf into the Hole: And the Noiſe doth, in all likelihood, proceed from a ſubterraneous Stream; which in Summer has room enough to vent all its Water; but in Winter, when Rains fall, the Paſſages between the Rocks cannot vent the Water; and therefore it regurgitates, and covers the Flats.

Theſe *Turloughs* are hard to drein; often they are encircled with Hills, and then 'tis not to be expected; often they have a Vent by which they ſend out a conſiderable Stream, and then it is only making that Paſſage as low as the bottom of the Flat, and that will prevent the Overflowing; it ſometimes happens that the Flats are as low as the neighbouring Rivulets, and in all probability, are filled by them; and then it is not only neceſſary to make the Paſſage from the Flat to the Rivulet, but likewiſe to ſink the Rivulet, which is very troubleſome, commonly the Paſſage to be cut being Rocky: And therefore a good Computation (upon a *Survey*) ought to be made, whether it be worth the while to attempt it. However, the Holes ought to be opened, that the Water in its Ordinary Courſe may get ſooner away: And they are to be eaten very bare towards the End of Summer, that as little Graſs as is poſſible may be ſpoiled by the Water.

The Motion of a Bog in Ireland; *By* —— n. 233. p. 714.

LXXIX. 1. *June* 7. 1697. near *Charleville*, in the County of *Limerick* in *Ireland*, a great Rumbling or faint Noiſe was heard in the Earth, much like unto the Sound of Thunder near ſpent; for a little Space the Air was ſomewhat troubled with little Whiſking Winds, ſeeming to meet contrary Ways; and ſoon after that, in the Bog of *Kapanibane*, upon the Eſtate of *Brook Bridges*, Eſquire, ſtretching North and South, the Earth began to move, *viz.* Meadow and Paſture-Land that lay on the ſide of the Bog, and ſeparated by an extraordinary large Ditch, and other Land on the further ſide adjoining to it; and a Riſing, or little Hill in the middle of the Bog hereupon ſunk flat.

This Motion began about 7 of the Clock in the Evening, fluctuating in its Motion like Waves, the Paſture-Land riſing very high, ſo that it over-run the Ground beneath it, and moved upon its Surface, rowling on with great puſhing Violence, till it had covered the Meadow, and is held to remain upon it 16 Feet deep.

In the Motion of this Earth, it drew after it the Body of the *Bog*, part of it lying on the Place where the Paſture-Land, that moved out of the place it had before ſtood; leaving great Branches behind it, and ſpewings of *Water*, that caſt up noiſome Vapours.

By Mr. J. Honoane, ib.

2. The Line *A. B.* is the *Meridian*; *C.* a *Meadow*, containing 3 *Engliſh* Acres, and 32 Perches; *D.* firm Paſture-Land (but of a coarſe Boggy ſubſtance) containing 4 Acres 3 Roods. The Line 1, 2, was a Hedge of large Aſh and Willow-Trees, between the Meadow and the firm Land; 3, 4, was the Edge of the Bog next to the Paſture. The pricked Lines from 3 to 5, and from 4 to 6 ſhew the Limits or Bounds of the Bog. The Meadow *C* was lower, by a Deſcent of 5 Foot, than the Paſture *D.* and the Paſture *D.* was lower, by 6 Foot than the Surface of the Bog. And there was yet a conſiderable rising and Hill, as at *E*, the Height whereof was more than 10 Foot above the ſurface of the Bog, ſo that there was a Deſcent from *E* to the Meadow. *Fig* 176.

The Cauſe of the Motion, I preſume, was this; a more than ordinary *Wet Spring* occaſioned a prodigious Swelling of the height of the Bog at *E.* and at length moiſtened the whole, but chiefly the under part thereof, the *Water* ſoaking to the bottom. By this means the *Turfy Hill E* being as it were undermined, naturally ſunk down, and conſequently preſſed the Bog on all hands; chiefly towards the Deſcent, till the Paſture *D.* was forced on the Meadow *C.* overturning the intermediate Hedge; ſo that the Line 3, 4, is now become 1, 2. and the Meadow and the whole Bog are level, only there are *Chaſms* and great *Cracks* throughout the whole Surface of the Bog, repreſented by the Stroaks about *E.* The Bog contains 40 Acres.

The Spaniſh Sembrador *and its Uſes; By the E. of* Sandwich, *n.* 60. *p.* 1056.

LXXX. In the Deſcription of this *Sembrador* (publiſhed by Don *Joſeph de Lucatello*, Knight, Inventor of the Engine, and dedicated to Signor Don *Geronymo de Camargo*, Counſellor of the *Conſejo Real de Caſtilla*, and of the *Hazienda Real)* it is repreſented;

Firſt, That both the Antient and Modern Huſbandman have agreed, that the Perfection of *Agriculture* conſiſted in ſetting the Plants in proportionable ſpaces, and giving ſufficient depth to the Roots, that they may ſpread enough to receive that Nouriſhment from the Ground which is neceſſary to produce and ripen the Fruit.

2. That Care hath not been had, in the Practice of this important Part of Huſbandry; ſince even at this day, all ſorts of Seeds of Corn and Grain are ſown by Handfuls, throwing them out by Aim, heedleſly and by Chance (counting it too tedious and chargeable to ſet them one by one in large Fields). Whence we ſee Corn ſow'd in ſome places too thick, in others too thin, and the greater Part of it not covered, nor deep enough; whereby it is not only expoſed to be eaten by Birds, but alſo in Cold Countries to be ſpoiled by Froſt, and in hot Regions, by the Sun: That upon theſe Conſiderations Don *Joſeph de Lucatello* hath, after much Experience, perfected an Inſtrument, which being faſtned to the Plough, at once ploughs, ſows, and harrows; whereby is ſaved the Labour of the Seeds-man; and the Grain falling in Order, and in the bottom of the Furrow, all of it remains in one and the ſame diſtance under Ground, ſo that of five parts of

Seed, four parts are ſaved; and then the Crop is gained incredible Abundance.

3. That the Inventor preſented it at the Feet of his Catholick Majeſty, who cauſed Trial to be made thereof in the *Buen Retiro*, where it did anſwer Expectation, notwithſtanding the Drought of the Year, then much damnifying all Corn; an ordinary Huſbandman, from a meaſured Space of Ground there, ſowed in the common manner, reaping 5125; where he, by his Contrivance from an equal ſpace of Ground there alſo, Reaped 8175, beſides the Seed ſaved in the Sowing.

4. That thereupon his ſaid Catholick Majeſty did grant to the Inventor, the Privilege, that he only and his Aſſigns may make and Diſtribute theſe Inſtruments, in all the Kingdoms and Provinces of that Monarchy in *Europe*, at the Price of 24 *Rials Plate* each, and out of *Europe*, 32 *Rials Plate*, of which the 5th Part ſhould be paid to the King: Prohibiting to all others the Making and Uſing this Inſtrument under ſeveral Penalties.

5. That before the Inventor came to the Court of *Spain*, he made a great Trial of it before his Imperial Majeſty, in the Fields of *Luxemburg* in *Auſtria*, where the Land uſually yields Four or Five fold: But the Crop from the Ground ſowed with this Inſtrument was Sixty fold, as appears by a Certificate given at *Vienna*, *Aug*. 1, 1663, *N. S.* by an Officer of the Emperor, appointed to ſee the ſaid Ground ſowed and reaped.

6. That this Privilege being diſpatched, he publiſhed his Contrivance and Inſtructions, as follows.

Fig.177, 178.

1. Fig. 177. Is a Box of Wood; *a. b. c. d.* the Cover of that Part where the Corn is put in; (which is open in Fig. 178. at *W.*) And *e. f. b. g. k. l.* the two Sides which cover that part of the Box, where the *Cylinder*, which is ſtruck round with 3 Rows of little Spoons, is moved about to throw out the Corn (which Sides are taken off in Fig. 178. to make the *Cylinder R. S.* with the *Spoons x. x. x.* appear.) The inner ſhape of theſe Sides is expreſſed in Fig. 179. where may be ſeen four Triangular Pieces *p. p. p. p.* leaving Triangular Interſtices *q. q. q.* which ſerve to convey the Corn carried up in the Spoons, and diſcharged at the Top of the *Cylinder*, ſo as they may juſt run out at the Holes underneath the Box; (the Parts of which anſwer to the Parts of Fig. 177. according to the Letters.) *T* is one of the Wheels; *V.* the other end of the *Cylinder*, upon which, the other Wheel is to be placed.

Fig.179.

Fig.180.

2. This *Sembrador* muſt be tied faſt to the Plough, in the manner as is ſeen in Fig. 180. ſo that the Corn may fall in the Furrow, and at the turning of the Plough, the Ears of the Plough may cover the Corn of the laſt Furrow with Earth.

3. Becauſe the Seed ſowed by this Inſtrument is placed in a convenient Depth, *viz.* in the bottom of the Furrow; whereas the Seed ſcattered the common way, remains nearer the Superficies of the Earth, or quite uncovered; therefore it muſt needs ſhoot forth ſomewhat later: ſo that it is requiſite the Huſband-man uſing this Inſtrument, ſhould ſow 8 or 10 Days ſooner than the accuſtomed Seed-time, *viz.* beginning to ſow in the middle of *September*, and making an end at the middle of *November.*

4. In ſtiff Ground the Furrows ought to be 5 or 6 Inches deep; in middle ſort of Ground, 6 or 7; and in light and ſandy Ground 7 or 8 Inches; and according to this Proportion, the Huſband-man muſt govern himſelf, deepening or ſhallowing the Plough, as the Condition of the Land ſhall require.

5. Special Care muſt be had, that the Wheels on the ſides of the Inſtrument do always turn round, and never drag along, without turning; as alſo, that the Ears of the Plough be made ſomewhat bigger that the ordinary ones.

6. 'Tis alſo convenient, that the Seed be well ſifted and cleaned; that ſo the little Spoons may every time take up a Grain, and the Seed be the better diſtributed.

7. In *Barley* 'tis to be well obſerved, that it be made clean in that manner, that the Straw and Beards be broken off, as near the Grain as may be; That ſo they hinder not the Iſſuing of the Grain, out of the Inſtrument.

8. After Seeds-time done, Furrows muſt be made to drein the Land of Water, according to the uſe of each Country, without doing any thing more extraordinary till the Harveſt.

The following Inſtructions were alſo publiſhed:

1. Before they ſow the Ground, they muſt give it ſo many *Tilths* as is accuſtomed in that Country where the Land lieth.

2. When they go about to ſow, the Plough-man muſt begin to open a Furrow with the Plough for one or two Paces; and when the Plough is in the Ground in a convenient Depth, then they muſt tie the *Sembrador* to the the Plough-Beam, ſo that the Nails in the Wheels may ſtand upon the Ground to make the Wheels turn round.

3. The Ears of the Plough are to be made larger than hitherto: Whence two Advantages will ariſe. 1. It will better côver the Furrows when ſown, and make wider Furrows to receive the Seed when they do ſow. 2. Thoſe larger Ears will prevent the Blows, the great Clods and Stones will give the *Sembrador* (if the Clods be not broken, and the Stones picked out.) But when there are ſuch Great Stones in the Land, as the Plough cannot penetrate, then the Plough-man, by lifting up his Plough, muſt paſs over it, until he meets with the Mould again; and ſo muſt the *Sembrador* alſo be lifted up, the Weight thereof being but very little, and no conſiderable Trouble to the Plough-man.

4. When the Clods and Stones cannot be maſtered with only one Pair of *Ears*,

Ears, you muſt add another Pair of them to the Plough, 4 or 5 Inches higher than the firſt, (chuſing a fit Place in the *Beam* to place them in) although behind the others a little; for ſo, the *Sembrador* will be perfectly ſaved and defended. And the *ſecond Ears* are to be of the ſame bigneſs with the firſt. And this is found, by Experience, to be the beſt Remedy againſt the Stones and Clods.

5. The time of ſowing, according to the moſt experienced Farmers, is when the Mould of the Land is dry, or but little inclining to Moiſture: In either of which Conditions of the Land, this new *Sembrador* works without clogging the Wheels, or ſtopping up with Dirt, thoſe Holes through which the Grain is to iſſue forth.

6. When this *Sembrador* works as it ought to do, it will ſow three *Celamines*, or about a Peck of Wheat, and five *Celamines* (or $\frac{1}{12}$ of a Buſhel) of *Barley*, on as much Land as would take up about one Buſhel and half after the common way of Sowing. And if it much exceed, or fail of this Proportion, it noteth ſome Fault in the Inſtrument, or Careleſneſs in the Plough-man.

7. The *Spoon* muſt be made for all Seeds, proportionably to their bigneſs.

8. You muſt plough the Furrows very cloſe one to another, that ſo the Plough when its turns back, may the better cover the laſt Furrow, which is left open, and ſowed as it came along.

9. After having ſown the Land, in the ſame manner the Land ſhould be made as plain as can be, and no ſuch Furrows made to carry away the Water as hitherto hath been uſed: But it will be ſufficient, that at every four Yards Diſtance (one from the other) Furrows be made. For Experience hath taught us, that the Land laid up without Furrows, bears more Corn, than that which hath more Furrows; becauſe the *Wheat*, and *Barley*, and other Plants, receive the greateſt Damage by Drought; and therefore this ought more eſpecially to be obſerved in *Spain*, one of the drieſt Countries of *Europe*.

10. In many Parts of *Spain*, in 1664, it was found, that Land ſown in *September* hath yielded a better Crop, than that which was ſow'd in *October*, and that ſown in *October*, better than that ſown in *November*; which proveth that 'tis more advantageous to ſow early than late.

11. They have obſerved alſo, that it is very profitable to ſow in the *New Moon*; becauſe it will ſhoot forth, and thrive, and ripen ſooner. In *Spain*, *Italy*, and the Iſlands of the Mediterranean, they may begin the firſt *New Noon* in *September*, and ſo go on, and end with the *New Moon* in *November*: But in *Germany*, and the *Low Countries*, they begin in the End of *Auguſt*, and end with the *New Moon* of *October*.

Agreſtick Obſervations and Improvements, by Dr. J. Beal, *n.* 116. *p.* 359.

LXXXI. It is vulgarly known, that the Surface of ſome Ground is ſo hollow, light, and ſwoln by a hot and working Ferment, that it muſt needs ſend up a warming Steam, as appears by the quick Riddance of all the Snow that falls on it, and (in many Places within my Knowledge) diſſolving the Snow before it falls on the Ground; that ſome Stones, by an innate *Warmth*, and ſome Waters do impregnate the Earth, and that other Stones, by their contrary Qualities, or by their Poſitions, have a quite contrary Operation; that Streams of Water running over *Lime-ſtones*, or thro' the Veins of *Marle*, or of that ſort of *Chalk* which is kind for Manure (for there is a ſort of *Chalk* which is *barren*) doth fertilize; that ſome other Waters are hungry, uliginous and corroſive; and that thoſe Rivers which are filled with a black Water, by Rain running over Heaths, do much Miſchief where they overflow, begetting *Heath* all over the *Paſtures*.

In the ſharpeſt Froſt that I have known theſe many Years, the Ground having been alſo ſome days covered with Snow, I ſaw a ſmall Stream (no bigger that might run from the Mouth of an ordinary *Quart Glaſs-Bottle*) ſliding merrily, and ſmoaking all the way, over the *Lawns*. I could not diſcern, that any Snow had fallen within five or ſix foot on each ſide; (if it did, none remained there; and ſo far the Graſs at that time, about *Chriſtmas*, was as green as any Leek, and the Froſt (ſo far) apparently diſſolved. Of this I then wrote to our worthy Friend Mr. *Evelyn*, not for any Wonder (for perhaps, there are, or may be Thouſands of ſuch *ſmoaking Streams* in *England*) but only repreſenting how ſuch a Stream may warm a Manſion, and cheriſh tender Ever-greens well ſheltered from Winds, and flowery Gardens, all the hard Winter, and do us better ſervice in an extreme hot Summer. I have been perplext in obſerving myſelf an hundred times, the difference of *Heat* and *Cold* between two Villages, within a Mile of each other, where we could obſerve no diſparity of Hills or Rivers; only the Springs in the one were all ſhallower; in the other, ſome were deeper. In a large Tract of Land the Surface was of ſo hot a Ferment, that at every Step I trod up to the Ankles. I cauſed it to be examined by the Spade, and found it, as far as I tried here and there, at a foot depth, as thick ſet with *Pebble-ſtones*, as if a Cauſey had been pitched there; yet was it a thick and pregnant Land for *Flowers*, *Fruit-Trees*, and *Vines*, theſe *Pebbles* being diſlodged, and ſome of them carried away. I have ſeen Fields, where the Surface did ſeem covered with *Pebbles*, not *Flinty* nor *Lime-ſtone*; yet they bore full Burdens of the beſt and cleaneſt *Rye* and *Oats*: The Huſband-men took away the *Pebbles* from off the Surface, and then the Land bore as ſtrong *Wheat*, *Peaſe* and *Barley* as before it bore *Oats* and *Rye*. In other parts where I have been, the Huſbandmen took away the Stones which ſeemed to cover the Fields, and ſuſtained great Loſs for their coſtly Labour; their Corn was much weaker for ſome Years after. I can attribute theſe differing Events to nothing but the Difference of Stones: Some intrinſically warm, and impregnating above Ground, ſome cold and not impregnating, whilſt in that Poſition or Situation. Yet ſome Experience forbids me to deny, that even ſuch Stones, when covered with Earth, at a certain Depth, may encreaſe the Fertility of the Land. And the hot and bibulous Land, which drinks up the Rain and Snow as ſoon as it falls, ſeems to have ſome cooling Refreſhment from under-Ground Pebbles which are of a cold, ſtiff, and ſullen nature.

What I have to ſay of *warming* and *fertilizing* Rocks, I ſhall deliver with an Aſpect towards *Scotland*, for *Horticulture*. I had ſeveral times Conference with Sir *Robert Murray*, B. M. (who was an Honour to his Country, and a Bleſſing to the Place where he abode) concerning *Eſculent* and *Olitory Gardens*, and (under one) *Nurſeries* of *Fruit-trees*, and other uſeful Vegetables in *Scotland*. I repreſented, that, almoſt within my Memory, they are become the chief Relief of *England*, that 'tis lately found, that *auſtere Fruit* yield ſtrong and ſprightful Liquor, which reſembles the *Wine* of the *Grape*, that the Return of Gain from *Gardens* is great and ſpeedy; *Nurſeries* neither are chargeable nor a burthenſome Addition, but a congruous Engagement of the Multitude to perſevere in the nobleſt kind of *Agriculture*. Sir *R. M.* granted all that I ſaid; and I am ſure, he acted, and executed all that he could for the Good of his own Country, and for *England*, &c. But, ſaith he, there are ſo many Rocks, and ſuch bleak Winds in *Scotland*, that they can hardly draw in the ſame Yoke with *England* for *Gardens* and *Orchards*. I replied, that in *Devon* and *Cornwall*, they fenced their *Gardens* and *Orchards* with *Flanders Firs* and tall *Holly* from the Sea-Winds; and they have lofty *Firs*, and goodly *Pines* in *Scotland*; and *New-England*, where the Winds are as keen, and the Snow and Froſt as deep, and as long laſting, as in many Parts of *Scotland*, is yet full of Fruitful *Orchards*. And if *Scotland* be farther in the North, yet *Norway* is rich in *Boſcage*, and the Seeds of the *Hemlock-Tree*, *Spruce* and *Cedars*, from *New-England*, *New-found-Land* and *Virginia*, may perhaps rejoice in the *Exchange* of *Northern America*, for the North of this Iſland.

This I told Sir *R. M.* I durſt undertake, that when *Edinburgh*, and their *Towns* and *Univerſities* ſhall plant *Kitchen-Gardens*, as we do now in *England*, they ſhall receive their grateful Reward the firſt Year, and bear the Charges of their Nurſeries abundantly, and ſo hold on; and within 7 Years, ſecure their Poſterity of the Benefit, and delight themſelves with the Fruit of their pleaſing Labour.

Now for fertilizing Rocks, I made bold to repeat it often, That within a Day's Journey of the Heart of *England*, I could ſhew 3 Gardens the beſt that I have ſeen for flowery Beauties, *Engliſh Ever-greens* and *Sallads*, all the *Winter* long; all theſe on a hard Rock, in moſt places but one Foot deep under Earth; in ſome two, in few Places three Foot deep; very lofty Hills cloſe on the South ſide, the Declivity of the Gardens due North; and the Rock perfectly bare next the Walls on the North ſide. And I ſaw rich *Hop-Yards* in the ſame Caſe, but in deeper Ground, next to the Garden on the South ſide of the Garden; and theſe *Northern Hop-yards* eſcaped many Blaſts, which ſeized on the *Hop-yards* on the South ſide of the Hill. On the ſteep Aſcent, on the North ſide of one of theſe rocky Hills, where no Plough could come, I ſaw a Gentleman Plowing up the ſhallow Turf with a Hand-Plough for *Flax*, and I ſaw good *Flax* grow there, to the Largeneſs of a Village-Field. His Hand-Plough had a Stem of *Aſh* or *Sally*, about 7 Foot long, and a Plate on one Side near the End, to turn the *Turf*; a Coulter to be let out ſhorter or longer, to cut the Turf 4, or 5, or more Inches deep, as the Land affords it; and a ſmall Iron-Wheel. This *Hand-Plough*, the Maſter and his Man by turns, drove before them with a walking ſpeed; having Leathern Aprons before them to ſave their Cloaths. For the Cauſes of this hardy Fertility, *Viderint Philoſophi*. I am ſure of the Truth of what I write, and I am willing to apprehend, that if in *Scotland* they did, in fit places, ſow the beſt Flax-ſeed of *Flanders*, as many here do, they would make good *Holland-Linnen*, *Laune*, and *Cambrick*, as now they do *Scotch Cloth*.

It is no hard Taſk to ſhovel down the ſhallow and moſſy Turf from the ſteepeſt Declivities of Rocks, into Places where it may have ſome Receptacle or Stay, and there to impregnate it with the Spade and Compoſt, for Gardens or Vineyards. And there the Tenth Part of an Acre in Gardening may yield more Profit than Ten Acres of ordinary Tillage in a Corn-Field.

I am ſo much a Stranger to *Scotland*, that I cannot ſay, whether *Saffron*, *Liquorice*, *Hops*, *Nadder*, *Oade*, or what other rich Commodities do proſper there; but this I know, that our *Engliſh Saffron* and *Liquorice* do far excel all the Foreign, which our Druggiſts do ſell us from the South. And ſince *Vines* and *Mulberries* have travelled from the remoteſt Eaſt, through all the hotteſt Countries, and have abundantly enriched our next Borderers, and have received acceptable Hoſpitality, as far as they have been tried, in this our Iſland; we have Encouragement enough to adventure the cheap and eaſy Trial.

Some of my Correſpondents tried the *Mulberry* and *Silk-Worm* as far in the Ibid. p. 364.
North as *Huntingdonſhire* and *Cheſhire*, and Sir *James Craig* tried them in the n. 143. p. 816.
moiſteſt Place in *Ireland*, in the County of *Cavan* in *Ulſter*; and all boaſted their Succeſs, *An.* 1651, 1652, 53, 54, 55. Wherever Mulberries grow, I am apt to expect, that the Worms will live, and ſpin, and furniſh the Silken Trade.

In *Devonſhire*, they mingle black Mulberries fully ripe, with a full-bodied Cyder, in the time of Grinding or Preſſing the Apple, with Diſcretion, for Tincture and Reliſh: And they eſteem it a very wholſome and ſtout Wine.

'Tis ſtrange, that in 9 or 10 Years ſince this was publiſhed, the Practice *Vide ſupra.* §. XXXIX.
hath not been ſpread into other Countries, where they abound with ſtrong 2.
and Winy Cyder; many being willing that their Cyder ſhould in Tincture reſemble *Claret*, *Tent*, or *Alicant-Wine*. But it may ſeem, that we do yet retain ſomewhat of our Fathers Averſeneſs from Planting *Mulberries*, which they ſhewed near the Beginning of King *James*'s Reign, to our great Loſs and Shame.

The *Mulberry* requireth a Rich, Succulent and Rank Ground, which is not wanting in the Approaches of any of our Cities and Towns. And Mr. *Evelyn* hath written as well as can be written, both to inſtruct, and to encourage the Planting of them.

The *Wine-Mulberries* (as we call them) are for the fineſt Silk; but to mingle with Cyder, and for our Junkets, (as *Palladius* hath hinted to us) we ſhould ſend for the moſt delicious black *Mulberries* which may be had in *Na-*

ples, *Sicily*, *Virginia*, or any of the *Eaſt* or *Weſt-Indies*, not truſting to the Seed, but by all Means to have young Plants, of the beſt ſorts, ſent in Boxes containing ſome of the connatural Soil. Thus if the Gardens about *London* were well furniſh'd, they might eaſily be diſperſed into other Parts, without more ado: For, few Plants may be more eaſily propagated, when they are young. A few rooted Mulberries being preſſed down, and covered with Earth in fit Places, ſo that the Eyes may be very lightly covered, and the Sprouts or Branches, if there be any, may be cut very near to the Ground; or a good Branch, after due depth of the bigger End in the Rich Mould, thus ordered as before, will ſoon become a perpetual Nurſery; and if the worſt Mulberries were well diſperſed, they may be ſoon amended, by putting the largeſt black Mulberry upon that of the ſame kind; it being certain, that it takes better upon that than upon the white Mulberry.

Vinous Shrubs are now coming into Faſhion; of theſe do ſome make Sugar-Wines by Art, to be compared (for Wholeſomneſs and Pleaſantneſs, to many Palates) with rich Wines of the Grape. For the Sugar-Cane doth hardly yield to any Vine in the World: And we hope that Meath, Metheglin, and other Honey-Drinks, will in a ſhort time give Place to theſe Sugar-Wines, when perfectly well made.

Beſides, 'tis good Employment for the poor Women and Children to gather the Fruit, and a ſpecial Improvement of our waſte Lands and Heaths, only by turning the Turf and burnt Heath (if there be any) into the Trenches and Pits, made by the Plough or Spade, for Banks or Beds.

n.134.p.866. Many diſcourage themſelves from Planting Cyder-Orchards, ſaying, that if they had the Fruit, they ſhould yet want many Matters, too coſtly for them. For their Sakes, I ſhall here inſtance, that in all the Neighbourhood round about *Yeoville* in *Somerſetſhire*, they that make 20 Hogſheads of Cyder, yearly, and much more, do pound all their Fruit in Troughs, made for the purpoſe, deep and ſtrong, with Broad-footed Pounders, one, two, or three, as their need requireth, pounding together in the ſame Trough. And to me they hold the Paradox ſtoutly, that without more Coſt or Trouble, this is the beſt and cheapeſt Way. Workmen are cheaper in the Country at ſome Seaſon, than in ſome Cities. And 'tis a Charity to employ Men that want Employment, rather than Beaſts; and ſometimes 'tis unſafe to truſt either to the Wind, or to the Water.

Cyder, you know, coſts no Fewel to brew it, and the Labour is but once in the Year.

'Tis drawn by divine Chymiſtry, ſo many Trees, ſo many huge Alembicks, which attend to that divine Work conſtantly all the Year; they need no Furnaces to ſend forth a corroding Smoke to choke all the City, to ſtrangle them into Conſumptions, and corrupt all Beauties and Amenities. Neither Iron, Steel, nor Marble, can reſiſt the Fumes of Brewing-Houſes: whereas Cyder is of a thouſand Kinds, proper to cure many Diſeaſes, and a kind of Vehicle for any Healing Vegetable, or other medical Matters.

The Cyder of the beſt Pepins duly ripen'd and kindly fermented, is a peculiar Remedy for the Conſumption, and generally all ſtrong and pleaſant Cyder exciteth and cleanſeth the Stomach, it ſtrengthens Digeſtion, and infallibly frees the Kidneys and Bladder from breeding the Gravel and Stone. This is (above all) the peculiar Excellency of the right *Red ſtreak* of *Irchin-Field*, when it eſcapes all Sophiſtications. But that which makes Cyder fit to accompany the Tradeſmens Granary, is, that if it be made of right Cyder-fruits, ſo that it will be full-bodied and ſtrong, it will hold good without Decay, and will yearly be much improved for ſome Years, to the next plentiful Year, as uſually it falls out, and beſt of all in large Veſſels, the larger the better. Tradeſmen ſhould not be for bottled Cyder, which is commonly more windy than healthful. It hath been tried from my Childhood in Veſſels of 14, 15, or 16 Hogſheads, of the free Houſhold-Meaſure, containing 60 or 70 Statute-Gallons: I have been often told, that Sir *John Winter* had a Veſſel which contained 30, or at leaſt 28 Hogſheads.

When the Citizens ſhall ordinarily drink Cyder well diluted, as the *French* drink Wine, and as the ſober People in all our Cyder-Countries drink their *Waſhings* of Cyder, as they call it, or Cyder well diluted in the Grinding-time, and as they drink in *London* their 6 *ſhilling* Beer, I am perſuaded it will much conduce to their Health: And I have often heard labouring People affirm, that they are more ſtrengthened for hard Work by Cyder largely diluted, than by very good Beer.

Yet I have much more to ſay for *Houſhold Gardens*, as a fit Match for *Granaries*. *Coleworts* and *Cabbages*, with a little Care, hold out 7 or 8 Months in the Year. We have them all the Year round; good Sauce for Bacon as red as any Roſe, as they have it in *Herefordſhire*, where the Swine will get a ſhare of the Fruit which fall from their Hedges; and the Bacon of *New-Foreſt* is generally commended. Theſe are in good Houſes always at hand, and may be eaſily dreſs'd without much Waſte of Time. But Roots of all ſorts, *Rapes*, *Turneps*, *Carrots*, *Parſneps*, *Skirrets*, *Potatoes*, do challenge the Precedence before *Granaries*; they are a kind of Under-Ground Granaries, and do oftentimes hold out, when Corn faileth; eſpecially the *Potatoes* of *Barbadoes* or of *Virginia*.

The *Potatoes* of *Barbadoes*, in our freſh Memory, relieved *Ireland* from two Years Famine, when their Corn failed there; as *Cheſtnuts* reliev'd *France* in the Extremity of their Civil War, when their Ploughs were forſaken. Theſe *Potatoes* coſt little or no Culture for ten Years together, being only covered with *Fern*, or other light Muck, and that turn'd in with the Earth, and two or three Roots, as often as there is occaſion to take any of them up for Uſe; and they ſhould be taken up here and there, by ſmall Parcels, where they grow thickeſt. A few Acres of theſe will run far to furniſh a City, and the Country round about. They have been ſold in the Markets of *Briſtol* and *Wells* at the Price of 4 *Shillings per Buſhel*; dear enough in reſpect of their eaſy Propagation and Culture, and cheap enough in reſpect of their Uſe. Children of poor People thereabout can eat them raw, inſtead of *Bread* and other Food, without hurt; ſome do roaſt them in Embers, as they do *Wardens*; ſome do boil them, peel them, and eat them with *Butter* and *Pepper*, either ſer-

Vide ſupra §. 8.

ved whole or chopt, as they do Parſneps; ſome do ſtrengthen their *Beer* or *Ale*, or make good Drink with them, ſo they are to them inſtead of Corn and Malt, and an acceptable Treat. Every way they are ſtrong and wholeſome Nouriſhment for Labourers. Some do parboil them ſlightly, peel them, and mince or cut 'em in ſmall Bits, mingle 'em with the Slices of fat Fleſh, ſeaſoning all to their Palate, and bake them in Pies or Paſties, and they eſteem them a reſtorative Delicacy, not much inferior to *Articboaks*. I obſerve them to grow and proſper abundantly in much differing kinds of Soil, from the North of *Shropſhire* to the Coaſt of *Dorſetſhire*. But they like not a ſtiff and ſtrong Land. I tried them 2 Years in a ſtrong Wheat-Land, and could get no good of them there; all the Roots which were there generated, were little bigger than the Bulbs of *Saffron*. In light and hollow Land of the hotteſt Ferment, which is commonly of little Worth for Corn or Paſture, there *Potatoes* thrive beſt and taſte beſt. But now I am at a Difficulty, whether the great Difference which we find in the Reliſh, be from the differing Kinds of the *Potatoes* of *Barbadoes* and *Virginia*, for both have the ſame Reſemblance above Ground: Or, whether the Difference which we find be only from the Diverſity of the Soil.

That the Soil makes a great Difference, and that all may be careful to chooſe a fit Soil for their Garden-Diet, I ſhall here offer ſome notable Inſtances to prove it. All the People here (the very Vulgar) do find the *Carrots* and *Turneps* or *Rapes*, from the Common Field of *Mariot*, 8 Miles from hence, Weſtward, far to excel other very good *Turneps* and *Carrots* in Fatneſs and pleaſing Reliſh. And *Cabbage-Plants* from the wild Fields of *Lydiard*, Weſtward of *Taunton*, where they have a rich reddiſh Soil, do ſo far excel all other the beſt *Cabbage-Plants*, that theſe *Lydiard*-Plants are bought in all Places at 80 Miles Diſtance, and Garden-Plants are ſometimes much altered in Taſte and Properties, by the Accidents of the Year. In a droughty Summer, the *Plague* then being hot in *London*, we had Carrots in *Northamptonſhire* from a kind Soil, where they were wont to be very good; but then ſo rank, dry, and earthy, that we could not endure to ſee them on the Table.

I hear that *Turneps* of *Hackney* are better than any other Turneps about *London*. We have here very good *Turneps* white and yellow, which are fatter and eſteemed more reſtorative. But all *England* wants the *Bohemian Turneps*, Blood-red on the Outſide, which are extolled by *Muffet*, as he found them in *Prague*, to be ſo reſtorative and delicate, that the Emperor himſelf nurſeth them in his Garden.

The *Spaniſh Potatoe* requires diligent Culture, much Sun and a light and pregnant Garden-Soil. In the Modern *Latin* they are called *Glandes Malacenſes*, being brought into *Spain* from *Volez Malaga*, a Province in *America*. They report, that more than a Dozen of their huge *Spaniſh* Ships were brought at one time to *Sevile* in *Spain*, fully Freighted with theſe *Potatoes*, and were ſoon diſperſed all over *Spain*. We ſay, the *Spaniard* is ſlow at every thing: But they may ſay, the *Engliſhman* in many Parts of *England*, is more ſlow at the beſt Improvements of our own Country; Witneſs our Want of Vineyards, of Groves, of Mulberries, of the beſt Cheſtnuts, Walnuts, Figs, Almonds, &c. which are wanting in moſt Parts, and do not refuſe to grow in our Climate.

Improvements of Agriculture, by Dr. M. Liſter, n. 25. p. 412.

LXXXII. For the Improvement of ſandy, light Ground, or any Clay well ſanded, I recommend upon Experience, *Vicia multiflora Nemorenſis Perennis, ſive Dumetorum*, J. B. It hath theſe Qualifications, beſide thoſe mentioned in the Title of *J. Bauhine, viz.* of its being Perennial, Thriving even in Woods and among Buſhes, and being of the Pulſe or Pea-kind, that it ſhoots 1000 Roots far and wide, and ſpreads itſelf under Ground, like *quick Graſs*; above Ground it is ſo rampant, that it will climb a Fathom and half upon Meaſure, and will preſerve itſelf in ſpite of Weeds or Drought. Again, it may be ſet as well as ſown in Furrows; and for this purpoſe, the Roots may be dug up in *September*, as well as the ripe Seed then gathered; by this means the Growth of it would be mightily advanc'd; for the older the Roots are, the ſtronger and fuller of Buds and Shoots they are. I ſowed the latter End of *March* the Seeds I had gather'd in *September*, and had that Year a very great Increaſe; the Bed being very thick cover'd over with Graſs above 2 foot high; but it did not flower that Year. I reckon'd, that one Pea had put forth that Year above 30 Shoots in *Auguſt*. In the ſecond Year, it flower'd by the middle of *June*, and bore a wonderful Crop, the Roots being innumerable. I have obſerv'd this Pea very common in all the Mountains as well as Plains of *England*, where Buſhes or Hedges are. Both the Pea and the Graſs are very ſweet, and very agreeable to Cattle, as I have tried.

Agriculture may be alſo conſiderably advanced, by the great Choice of Plants, even of thoſe of our own Growth, of the Pulſe-kind; of which I recommend this Liſt:

Lathyrus major Latifolius Ger.
Lathyrus Luteus Sylveſtris Dumetorum L. B.
Aſtragalus Sylvaticus Ger.
Vicia Sylveſtris Semine rotundo, Nigro, C. B.
Orobus Sylvaticus noſtras C. B. P. in Append.
Vicia Sylvatica Multiflora maxima P. B.

I alſo recommend as Subſtitutes of *Hemp* and *Flax*, of our *Engliſh* Growth, *viz.* Perennial Plants:

Linum Sylveſtre Anguſtifolium J. B.
Linum Sylveſtre Floribus Cæruleis Ger.

Corona Fratrum; of the *Thiſtle-Kind*. This Plant is generally a Yard tall; its Fibres are exceeding tough and ſtrong, beyond any I ever tried; it puts forth many of theſe tall and very thick Stalks yearly; it naturally grows to this Bulk in moſt barren Soils, as the dry Woolds and high Paſtures, in *Yorkſhire* and *Lincolnſhire*.

It may be objected, that as Annual Plants require more Labour and a fatter Soil; ſo they recompenſe it in Largeneſs of Growth and Fruits: And alſo that Plants of laſting Roots are more harſh and bitter, and not palatable for Man or Beaſt. I anſwer, that the Compendium of Labour in *Huſbandry* is all in all; and that therefore the durable Plants will turn to better account: I refer to the wonderful Examples of ſuch as have already been made uſe of at St. *Foin*, *&c.* And it is probable, that by ſome Tillage, even harſh Plants, may be improved, and brought to be kinder Food. The ſame *Aſparagus* which we eat, grows wild in the Marſhes of *Lincolnſhire*, very fair, and not to be diſtinguiſh'd by the Eye from that of our Gardens; but is intolerably bitter, which Garden-Culture alone has Civiliz'd, and made pleaſant to the Taſte. For this purpoſe, Liming of Paſture-Ground makes it palatable to Cattle: For caſt Lime over the one half of a Paſture, the Cattle will not bite any where elſe willingly, and will Eat here to the bare Ground, much neglecting the other half. I did uſe, when I liv'd in the North, to Lime my *Aſparagus* and *Lettice-Beds*; and this did ſo far meliorate them, that they far exceeded in Tenderneſs, and pleaſant Taſte; covering the *Aſparagus* in Winter, with clean Wheat-ſtraw, inſtead of naſty Litter, and ſowing the Bed thick with the Powder of Burnt Oiſter-ſhells.

Perhaps *White Briony*, of all our *Engliſh* Plants, would beſt ſucceed both for Hay and Corn, as giving the moſt Graſs, if we would that way uſe it; and alſo yielding a Root of a prodigious bigneſs; which ſeaſonably taken up, is little elſe but a Maſs of fine Flour. 'Tis true, it is a churliſh Purge, and not fit Food for Man, or any other Animal we keep: But ſuch, and much worſe, is the *Callava-Root*, of which the *Indian* Bread is made, and which by Exſuccation and Baking alone, proves innocent and wholeſome. If the vaſt Shoots it makes be deſigned for Hay, they are to be cut when tender, and in the Flower.

To make Plants grow to an extraordinary bigneſs, by M.. n. 156. p. 356

LXXXIII. Sow all ſorts of Grains, and plant Kernels in Beds of Earth, at the very time when the Sun enters into the *Vernal Æquinox*, and take them up when they are ſtrong enough to be tranſplanted, at the Time of the Full Moon; which Time is always to be obſerved, if you will take them up and Replant them.

But now, to know the Moment, or very near the Moment, of the ſaid *Æquinox*, take ſome Aſhes of *Vine*-Wood, put them in an Earthen Pot Leaded, or in a Pot of the white Earth of *Tayence*, very clean; pour upon it common Water, or Fountain, or Rain-Water, that is very clear, from the $\frac{9}{19}$ of *March* to the $\frac{11}{21}$ of the ſame; and at the time when the Sun enters into the Æquinoctial Point, you will ſee the Aſhes make the Water Turbid, and then is the Time of ſowing your Grains and planting your Kernels.

Gardening improved, by Dr. Hans Sloane, *n. 251. p. 119.*

LXXXIV. I am of Opinion, that one conſiderable way to improve Gardening, and the Culture of Plants, would be, to give a Deſcription of the Plants themſelves, then the Soils, Climates and Countries, where the Vegetables to be cultivated naturally grow; and what Seaſons, Rains and Meteors they have: Which being imitated, as much as poſſible, perhaps ſome

Plants might thrive better, than now they do in the fatteſt Ground. And to this purpoſe I have been aſſured by an honourable and very ingenious Perſon, that he has known ſome Plants, particularly the *Centaurium Minus*, which not growing the ordinary way, was tried, by dropping the Seed on the ſurface of the Ground amongſt the Graſs, by which artificial Imitation of Nature it came to perfection, which no other way could be brought about.

The Succeſs of a new Stove, by Sir Dudly Cullum, n. 218. p. 191.

LXXXV. I have made a Stove in my Green-houſe, according to Mr. *Evelyn*'s Invention, publiſh'd in the *Calendarium Hortenſe*. I laid my Pipes of crucible Earth, not too near the Fire-Grate, which is about 16 Inches, and I made a Trench the whole length of my Houſe, under the Paving, about 18 Inches in Breadth and Depth, covered with an Arch of Bricks, and at the other End of the Trench, having an Iron-Plate about 18 Inches ſquare, to take off and put on, with a round Hole at each Corner, of about 3 Inches Diameter, with a Lid to ſlide open and ſhut; ſo that by opening any of theſe Holes, or all of them, more or leſs, or taking off the whole Plate, I can releaſe ſuch a Quantity of Air out of the Houſe, to blow the Fire ſo as to increaſe or diminiſh the Blaſts; and, as Mr. *Evelyn* was pleaſed to inform me by a Letter, concerning diſtributing the Air at its Admiſſion, more equally through the Houſe, I inſerted my Pipes into a Channel all along the Wall, at the End of the Houſe, with thoſe ſeveral Overtures he mentioned; all which prove admirably.

To make Fruit and Flowers grow in Winter, by Sir Robert Southwell, *n.*237. *p.*44.

LXXXVI. Take up Trees by the Roots in the Spring, juſt as they put forth their Buds, preſerving ſome of their own Earth about the Roots; ſet them ſtanding upright in a Cellar until *Michaelmas*; then put them into Veſſels, with an Addition of more Earth, and bring them into a Stove, taking care to moiſten the Earth every Morning with Rain-Water, in a Quart of which you muſt diſſolve the bigneſs of a Walnut of *Sal Armoniac*, and about *Lent* Fruit will appear.

As to Flowers, Take good Earthen Pots, and therein ſow your Seed at *Michaelmas*, Watering it in the ſame manner with the like Water, and by *Chriſtmas* you will have Flowers, as *Tulips*, *Lilies*, &c.

This and the other may be done in a good warm Kitchen; and ſuch Days as the Sun ſhines, you may ſet them forth for ſome Hours.

To keep Fruit and Flowers the whole Year, by Sir Rob. Southwell, *n.* 237. *p.* 44.

LXXXVII. Take *Salt Petre* one Pound, *Bole Armoniack* two Pounds, ordinary clean Sand three Pounds; mix all together, and obſerve this Proportion in other Quantities.

Then in dry Weather, take Fruit of any ſort that is not fully ripe, each with its Stalk; put them in, one by one, into an open Glaſs, till it be full; and then cover it with an Oily Cloth, cloſe tied down; then in a dry Cellar, put each of theſe Glaſſes four Fingers under Ground, and ſo as that quite round each Glaſs, and above and below, there remain two Fingers thick of the ſaid Mixture.

Flowers alſo may be uſed in the ſame manner.

Remedies for decayed Evergreens, by Mr. J. Evelyn, *n.* 158. *p.* 561.

LXXXVIII. I would adviſe ſuch as ſuffer Detriment in their *Green-Houſes*, not to deſpair, when they ſee the Leaves of their *Myrtles*, *Oranges*, *Oleanders*, *Jaſmines*, and other precious Fruits, Ruſſet, or altogether ſhrivell'd and falling, but to cut them to the Quick, plaiſter the Wounds, and plunge their Caſes and Pots, trimmed with freſh Mould, *&c.* in a warm Bed, carefully refreſhed, ſhaded, aired, and treated as ſick Patients, and as the prudent Gardiner beſt knows how. But above all, that he be ſure, not to expoſe them, till the Eaſtern Winds, which I call our *Engliſh Eteſians*, and which make our Springs ſo uncomfortable, when we think Winter and all Danger paſt, be qualified: For they are deadly to all our Plants abroad, and frequently do us more Prejudice than the moſt churliſh Winters, as commonly finiſhing the Deſtruction of what the Froſts have ſpared. Nor are we to be flattered with a warm Day or two, which are apt to tempt Gardiners to ſet out their Plants before the End of *April*, or that we find the wiſe Mulberry put forth, which is certainly the moſt faithful Monitor: Nor ſhould we indeed, cut or tranſplant any of the *Perennials*, till of themſelves they begin to ſprout.

Cautions about expoſing Evergreens, by Mr. Jacob Bobart. *n.* 165. *p.* 777.

LXXXIX. In the Spring, being flattered with ſome warm Glances and refreſhing Days, many are apt to expoſe their choice Greens, which upon a ſudden change to its former Cold with ſharp Eaſtern Winds, proves more pernicious to ſuch Strangers than all the former Winter, and ſeems to finiſh the Deſtruction of what the former Cold had ſpared, a Matter too frequently ſeen among us, we enjoying no certain ſteady Summer till after the *Solſtice*. But theſe tender Exoticks loſing their Leaves, having receiv'd Detriment, with their Tops ſhrivell'd, and the like, are oftentimes not capable of enduring the interpoſing ſcorching Heat of the Sun, which oftentimes happens by Fits in the Spring; when the Prudence and Care of the Gardiner is eſpecially try'd, gradually to help and recover his ſick Patients, ſometimes by due Trimming, Earthing with freſh Suſtenance, looſening the ſtrait bound Earth, and ſometimes with the help of a warm Bed, and gentle watering and ſhadowing, and the like, patiently and carefully waiting the Return of the Bounty of the Heavens to help his Endeavours.

Vide ſupra, cap. 1. §. 53.

In the Flower-Garden, eſpecial Obſervance ought to be taken of the choicer Roots of the *Aſian Ranunculi*, *Aulmoneys*, tender *Narciſſi*, and divers others of the like Tenderneſs, and Strangers to ſuch Entertainments as our Northern Countries afford; that if hard Froſt ſhould happen, they ſhould be ſecurely cover'd and kept from the Froſt, if poſſible, till the too rigid Moiſture of the Earth be digeſted, which would prove pernicious even to the Death and Rottenneſs of many ſuch Roots and Plants.

XC.

XC. *Papers of leſs General Uſe, Omitted.*

1. DIrections for Tranſporting *Vegetables*. n. 40. p. 793.

2. *Phytologia Tingitana*: Or, an Alphabetical Catalogue of Plants growing within the Fortifications of *Tangier*, 1673, by Mr. *Spotſwood*. n. 200. p. 239.

3. A Catalogue of ſome *Guinea*-Plants, with their Native Names and Virtues; ſent by Mr. *J. Smith*, from *Cabo Corſo*; with Remarks on them, by Mr. *James Pettiver*. n. 232. p. 677.

4. An Account of 46 *Eaſt Indian* Plants, collected at *Unanercoonda*, about 12 Miles from *Fort St. George*; by Mr. *Sam. Brown*, with their Names, Deſcriptions, and Virtues, by Mr. *James Pettiver*. n. 244. p. 313

5. An Account of Part of a Collection of curious Plants and Drugs, gathered by Mr. *Sam. Brown*, a Phyſician at *Fort St. George* in the *Eaſt Indies*, and lately given to the *Royal Society* by the *Eaſt-India* Company. With Remarks, by Mr. *Pettiver*. n. 236. p. 1. n. 204. p. 579. n. 267. p. 699.

6. Quæries concerning *Indico*, by ——— n. 193. p. 504.

7. Quæries concerning Vegetation, eſpecially the Motion of the Juices of Vegetables, by ——— n. 40. p. 797.

8. Quæries concerning the Circles of Wood in the Bodies of Trees, and the Motion of Sap, by Dr. *Ez. Tonge*. n. 43. p. 858. 867. n. 46. p. 919.

9. Quæries concerning Vegetation, and the Motion of Sap in Fruit-Trees, by Dr. *Ez. Tonge*. n. 44. p. 881. n. 46. p. 914.

10. Quæries concerning Vegetation, and the Motion of Sap, by Dr. *Ez. Tonge*. n. 57. p. 1165

11. Enquiries about Retarding the Aſcent of Sap, and the Motion of Sap, by Dr. *Ez. Tonge*. n. 68. p. 2073

12. Some further Enquiries concerning the Running of Sap in Trees, colouring the Fruit and Leaves, multiplying *Crab-ſtocks*, and propagating Trees by Layers, *&c.* by Dr. *Ez. Tonge*. n. 68. p. 2074

13. Enquiries relating to the Circulation of Sap in Trees, by Dr. *Martin Liſter*. n. 70. p. 2121

14. An Enquiry ſuggeſted from *Italy*, whether it be likely to find ſomething in Plants, analogous to the Heart in Animals. n. 74. p. 2218

15. An Invitation to make further Trial of the Juices of Trees, by Tapping them, by Mr. *H. Oldenburgh*. n. 40. p. 801.

16. Two Problems concerning the Texture of Plants, and the Diſcovery of Poiſon by *Ogium*, propoſed by ——— n. 252. p. 186.

17. Enquiries concerning Agriculture, by the Committee of the Royal Society for conſidering of Agticulture. n. 5. p. 91.

18. Enquiries concerning the Uſe and Culture of the Kitchen-Garden, and Winter-Greens, by ——— n. 40. p. 799

XCI. *Accounts of Books, and Additions, Omitted.*

n.243.p.304 1. B*Aſis Botanica:* Seu brevis ad *Rem Herbariam* Manuductio, omnes *Plantarum* Partes, una cum earundem *Virtutibus* ſecundum Noviſſima *Botanicorum* Fundamenta, Generali quadam Methodo commonſtrans; à D. *Chriſtiano Ludovico Welchio.*. *Lipſ.* 1697, in 12*mo.*

n.96. p.716. 2. *Abr. Couleii Angli*, ſex Libri *Plantarum*, Poemate *Latino* conſcripti, *Lond.* in 8*vo.*

n 46. p 934. 3. *Præludia Botanica Roberti Moriſon, Scoti Abredonenſis, Lond.* 1669, in 8*vo.*

n.114. p.327 4. Dr. *Moriſon*'s New *Univerſal Herbal.*

n.46. p 935. 5. Cl. *Salmaſii* Præfatio in Librum de *Homonymis Hyles Iatricæ.* Ejuſdem de *Plinio* Judicium. *Divione An.* 1668, in 4*to.*

n.76.p.2291 6. Quadripartitum *Botanicum Simonis Pauli*, Med. Reg. in *Dania Argentorati*, in 4*to.*

n.111.p.247 7. Waare Oeffening der *Planten*, door *Abraham Munting*, M. D. *Amſterd.* 1672, in 4*to.*

Ph. Col. n.1. p. 39. 8. *Memoires* pour ſervir à l' *Hiſtoire* des *Plantes*; dreſſez par M. *Dodart*, M. D. *Paris*, 1679.

n.186.p.283 9. *Hiſtoria Plantarum*, ſpecies hactenus editas, aliaſque inſuper multas noviter inventas & deſcriptas complectens. Auth. *Joh. Rai*, è *Soc. Regia. Lond.* 1686, in *Fol.*

n.193.p.528 10. *Phytographia.* By *Leonard Plukenet*, M.D. *Lond.* 1691, in *Fol.*

n.196.p.618 11. *Almageſtum Botanicum*; S. *Phytographiæ Plukenetianæ, Onomaſticon*, &c. *Lond.* 1696, in *Fol.*

n.225.p.434 12. *Catalogus Plantarum Angliæ*, & *Inſularum adjacentium tum* Indigenas,
n.63.p.2058 tum in Agris paſſim Cultas complectens. Opera *Jo. Raii*, M. A. 1670, in
n.133.p.834 12*mo* & 1677, in 8*vo.*

n.83.p.4078 13. The *American Phyſician:* or, a Treatiſe of Roots, Plants, Trees, Shrubs, Fruits, Herbs, *&c.* growing in the *Engliſh Plantations* in *America:* Whereunto is annexed a Diſcourſe of the *Coco-Nut-Tree*, and the uſe of its Fruit. By *W. Hughs*, *Lond.* 1672, in 12*mo.*

n.221. p.93. 14. *Catalogus Plantarum* quæ in Inſula *Jamaica* ſponte proveniunt, vel vulgo coluntur; cum earundem *Synonymis*, & *Locis Natalibus*; adjectis aliis quibuſdam quæ in Inſulis *Maderæ, Barbados, Nieves,* & *Sancti Chriſtopheri*, naſcuntur. Seu *Prodromi Hiſtoriæ Naturalis Jamaicæ*, Pars prima. Aut. *Hans Sloane*, M.D. 1696, in 8*vo.*

n.104. p.87. 15. *Icones* & *Deſcriptiones Rariorum Plantarum Siciliæ, Melitæ, Galliæ,* & *Italiæ*; Auth. *Paulo Boccono*, 1674.

16. *Muſeo* de *Piante Rare* della *Sicilia*, *Malta*, *Corſica*, *Italia Piemonte* è *Germania*, *&c.* di Don *Paolo Boccone*, *&c. To which are here added, ſome Remarks, by* Mr. *J. Ray.* n.247.p.482

17. *Hortus Indicus Malabaricus*, continens Regni *Malabarici* apud *Indos* Celeberrimi, omnis generis *Plantas Rariores*, *Amſtel. An.* 1678, 1679, 1682, *&c. To which here are added ſome Remarks, by* Tancred Robinſon, *M. D.* n.145.p.100 n.198 p.682 n 200.p.262 n.214.p.276

18. *Hortus Medicus Amſtelodamenſis*, ſive *Plantarum* tam *Orientalis* quam *Occidentalis Indiæ*, aliarumq; *Peregrinarum* Deſcriptio & Icones; Autore *Johanne Commelino*; *Latinitate* donatus, *Notis & Obſervationibus* illuſtratis à *Frederico Ruyſchio*, M. D. Botan. Profeſſ. &c. & *Franciſco Kiggelario. Amſt.* 1697. *Here are many Additional* Remarks *by Mr.* James Pettiver. n.236.p.29

19. *Paradiſus Batavus*, continens plus centum *Plantas*, &c. *With Additional Remarks, by Mr.* Jo. Ray. n.249 p.63

20. *Catalogus Plantarum Horti Academici Argentinenſis* in Uſum *Rei Herbariæ* Studioſorum; adcurante *Marco Mappo*, M. D. *Argentorati.* 1691, in 12*mo.* n.199.p.729

21. *Hiſtoire* des *Plantes* qui naiſſent aux environs de *Paris:* avec leur *Uſage* dans la *Medicine*; per M. *Pitton Tournefort*, M. D. à *Paris* 1698, in 8*vo.* n.245.p.385

22. *Flora Noribergenſis*, &c. Being a Catalogue of ſuch Plants as not only grow *ſpontaneouſly* about *Nuremberg*, but alſo of ſuch *Exoticks* as the Phyſick-Garden of that City hath lately raiſed; with the Figures and Deſcriptions of many of the moſt Rare. By *Jo. George Volkamer*, M. D. 1700, in 4*to.* n.265.p.651

23. *Plantarum Umbelliferarum Diſtributio Nova* per Tabulas Cognationis & Affinitatis, ex Libro Naturæ Obſervata & Detecta; à *Rob. Morriſon*, Med. & *Prof. Bot. Regio*, &c. *Oxonii*, 1672. n.81 p.4017

24. De *Abſynthio* Analecta, per *Joh. Michael Febr.* M. D. *Lipſiæ*, 1668, in 8*vo.* n.74.p.2235

25. *Crocologia*, Auth. *Joh. Ferdinando Hertodt.* M. D. *Jenæ*, 1671, in 8*vo.* n.74.p.2236

26. *Cochlearia Curioſa:* or, the Curioſities of *Scurvygraſs*; written in *Latin* by Dr. *Andr. Molimbrochius* of *Leipſig*, and *Engliſhed* by Dr. *Tho. Sherly*, *Lond.* 1678, in 8*vo.* n.125.p.621

27. *Joh. Nicholai Pechlini*, M. D. *Theophilus Bibaculus*; ſive de *Potu Theæ* Dialogus *Fran.* 1684, in 4*to.* n.167 p.870

28. Epiſtola de *Generatione Plantarum* ex *Seminibus*, à *Joſepho de Aromatariis. Frankf.* 1625. n.211.p.150

29. The *Anatomy* of *Vegetables* begun; with a general Account of *Vegetation* founded thereon. By *Neh. Grew*, M. D. F. R. S. *London*, 1671, in 12*mo.* n.78.p.3037

30. An Idea of a *Phytological Hiſtory* propounded; together with a Continuation of the Anatomy of *Vegetables*, particularly proſecuted upon Roots, and an Account of the Vegetation of *Roots*, grounded chiefly thereupon. By. *Neh. Grew*, M. D. & F. R. S. *London*, 1673, in 8*vo.* n.97.p.6131.

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n.150.p.303 32. The Anatomy of Plants, with an *Idea* of a *Philoſophical Hiſtory* of Plants; and ſeveral other Lectures, read before the *Royal Society*. By *Neh. Grew*, M. D. 1682.

n.117.p.401 Ph. Col. n. 1 p. 38. 33. *Marcelli Malpighii Anatome Plantarum*; cui ſubjungitur, Appendix, iteratas & auctas ejuſdem de *Ovo Incubato* Obſervationes, continens. *Lond.* 1675, & 1679, in *Fol.*

n.226.p.320 34. The *Poſthumous Works* of S. *Malpighi*. In this Account of them, S. *Jean Marie Lanciſi* gives an *Encomium* and *Character* of the *Author*.

n.228.p.545 35. *Marcelli Malpighii* Philoſophi & Medici *Bononienſis*, è *Regia Soc. Lond. Opera Poſthuma*: Fig. Æneis illuſtrata; quibus præfixa eſt *Ejuſdem Vita*, à ſeipſo ſcripta. *Lond.* 1697, in *Fol.*

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n.15.p.62. 46. The *Engliſh Vineyard* Vindicated. By. Mr. *J. Roſe*.

47. The *French Gardiner*, reprinted: To which is annexed, the *Engliſh Vineyard*, *Vindicated*, and the way of making and ordering Wines in *France*, in 8*vo*. *n.*126.*p.*646

48. *Vini Rebnani* imprimis *Baccaracenſis*, Anatomia Chymica, à *Job. Davide Portzio*, Phil. & Med. D. *Heidelbergæ*, 1672, in 12*mo*. *n.*93.*p.*6019

49. Joh. Henr. Meibomii de Cereviſiis, Potibuſque & Ebriaminibus extrà Vinum aliis Commentarius, annexo Libello Turnebi de Vino. Helmeſtadii, 1668, in 4*to*. *n.*69.*p.*2116

50. *Vinetum Britannicum*: Or, a Treatiſe of *Cyder*, and ſuch other *Wines* and *Drinks*, as are extracted from all manner of *Fruits*, growing in this Kingdom: With the Method of Propagating all *Vinous Fruit-Trees*; and a Deſcription of a new invented *Ingenio* or *Mill*, for the more expeditious and better making of *Cyder*. Alſo the Method of making *Metheglin* and *Birch-Wine*. With Copper Plates. By *J. W.* (Author of *Syſtema Agriculturæ*) in 8*vo*. *Advertiſements on this* Book *are here added*, *by Dr.* Beale. *n.*123.*p.*574 *n.*115.*p.*352.

51. The Manner of *Raiſing*, *Ordering*, *and Improving Foreſt-Trees*: Alſo how to *Plant*, *Make*, and *Keep*, *Woods*, *Walks*, *Avenues*, *Lawns*, *Hedges*, &c. With ſeveral Figures proper for *Avenues* and *Walks*, to end in; and Convenient Figures for *Lawns*: Alſo Rules and Tables ſhewing how the Ingenious Planter may meaſure Superficial Figures; with Rules how to divide Woods and Land; and how to meaſure *Timber* and other Solid Bodies, either by *Arithmetick*, or *Geometry*, &c. By Mr. *Cook*, in 4*to*. *n.*124.*p.*583 *n.*126.*p.*644.

CHAP. VI.

ZOOLOGY.

Obſervations in the Ordering of Silk-Worms; *by Mr.* Edward Digges, *n.*2. p. 26.

I. 1. I Have kept Leaves 24 Hours after they were gathered, and flung Water upon them to keep them from Withering: Yet when (without wiping the Leaves) I fed the *Silk-Worms*, I obſerved they did as well, as thoſe freſh gathered.

2. I never obſerved that the Smell of *Tobacco*, or other Smells that are rank, did any ways annoy the *Worm*.

3. Our Country of *Virginia* is very much ſubject to Thunders: And it hath Thundered exceedingly when I have had Worms of all Sorts; ſome newly Hatched; ſome half way in their Feeding; others Spinning their *Silk*; yet I found none of them concerned in the Thunder, but kept to their Buſineſs as if there had been no ſuch Thing.

4. I have made many bottoms of the Brooms (wherein hundreds of Worms ſpun) of *Holly*; and the Prickles were ſo far from hurting them, that even from thoſe Prickles they firſt began to make their Bottoms.

The Nature and Qualities of Silk; *by Mr.* Will. Aglionby. *n.* 252. *p.* 183

II. Silk, which is the Spittle of a Worm, hath its good or bad Quality from the Nouriſhment the Worm receives either from a good or bad Leaf. When the Spring proves delightful and ſweet, the Worm feeding on a good and tender Leaf, free from the Prejudices of an unkind Seaſon, (which ſometimes ſpoils the Leaf, by giving it a rough, groſs, and heavy Nature) then one may expect a profitable Harveſt; and in ſuch Years 'tis beſt to make a good Proviſion; for Silk will then find good Sale when moſt Abundance, and the Buyer meets with that of a good Subſtance, which the Advantageous Seaſon very much contributes to; but not knowing how long it may laſt, about Midſummer (or St. *John's-Tide*) they begin, in *Piedmont* to draw the *Silk* from its *Cocon*, to ſee what it yields, and judge of its Increaſe or Scarcity, as well as the Eſtimate of its Goodneſs and Perfections; thoſe moſt deſirable are, that it proves clean, light and ſtrong.

In Caſe the Seaſon ſhould not prove plentiful, then they buy as faſt as they can *old Silk*, and keep as much as they can of the other, for the beſt Fabricks; that ſo they may not be obliged to hazard all their good, at the price of the worſt; which is commonly practiſed: But if the Seaſon promiſe a great and ſatisfactory Harveſt, they take the new, and put it apart for the beſt Fabrick; not deſpiſing the old, but only laying it aſide till Proof be made whether the new better or not.

To know the beſt Silk.

The Goodneſs of *Silk* is diſtinguiſhed by its Lightneſs, as the moſt Eſſential Quality; which every Body knows, carries a conſiderable Profit along with it, when bought by Weight, and ſold by the Yard or Aune. It is to be noted, that the *Organcine* is *Superfine*, it being the beſt ſort; and note, That the two Threads are equal in Fineneſs, that is to ſay, both alike in ſmoothneſs, thickneſs and length, for the Thread of the firſt Twiſt: For the ſecond, it matters not whether the ſingle Thread be ſtrong before the two are joined, unleſs to ſee whether the firſt Twiſt prove well. It is neceſſary the *Silk* be clean, the *Straw-colour* is commonly the lighteſt, and the White the heaviſt of all. It is likewiſe convenient that the Skeans be even, and all of an Equality, which ſhews they were wrought together; otherwiſe with great Reaſon one may ſuſpect that it is *Refuſe-Silk*, and cannot be equally drawn out and ſpun; for one Thread will be ſhorter than the other, which is Labour and Loſs. It will be alſo requiſite to ſearch the Bale more than once, and take from out of the Parcels a Skean to make *Eſſay*; for unleſs one buys that which one knows by Trial, there is a Hazard of being cheated, and ſo for one ſort have another.

To Eſtimate it by Eſſay.

To eſtimate the *Silk* by *Eſſay*, fix the *Eſſay* upon the eighth of a *Portee*-Hand of *Silk*, of 110 *Aunes* of *Lyons* in length, and ſee what it makes of *Aunes* by the eighth Part, the Skean which is of 80 Threads, muſt be multiplied by 110, which is the Length of the 110 *Aunes*, from which Number muſt be deducted one Eighth; as for Example, 110 by 80, makes 8800, the eighth Part of which is 1100, which is the eighth Part of a *Portee*. Now to calculate what theſe 1100 *Aunes* weigh, which is the eighth Part of a *Portee*, or of 110 *Aunes* of *Lyons*, it will be proper to take a Skean out of the Parcels, which you take from out of the Bale, which you judge may contain at leaſt 1100 *Aunes*, to make the one eighth Part of a *Portèe*; which *Portèe* muſt be divided on 2 Bobbins half on each, then fix the 2 Bobbins on the *Cantrè* (*Beam*,) and from thence paſs it through the (*Combe*) *Hourdiſſoir*; this done, you cut off your *Silk* and weigh it, and multiply the Weight by 8, it will weigh juſt as much as a *Portèe* of 110 *Aunes* of *Lyons*: Which is the general Rule of calculating, when they draw the *Silk* out. By this means one may learn to adjuſt the Weight. There are *Silks* of *Piedmont* which are very light and clean, and to be preferred before any in *Sale*. The *Portèe* of *Silk* of the lighteſt weighs near 24 *Penny Weight*, to 25 and 26. Others 27 and 28; which *Weight* may be diſpenſed with, on Condition the other Qualities be as good, to wit, well wrought, even, fine and clean; but above theſe *Weights* they cannot be, unleſs they abate of their Profit, proportionable to what they want in lightneſs.

The Connought-Worm; By Mr. Will. Molyneux: *n.* 108. *p.* 876.

III. The *Connought-Worm* which I find in *Godartius* of *Inſects*, deſcribed by the Name of the *Elephant-Caterpillar*, is reported to be the only poiſonous Animal in the Kingdom of *Ireland*. One of them was ſent alive to me from the Country, about 40 Miles from *Dublin*: The Gentleman that ſent it, had kept it above 6 Weeks in a large Box on a Graſſy Sod, now and then giving it a freſh *Sod*, and *Ragwort* to eat, beſprinkling them with Dew. Some of theſe Worms are as thick as a Man's Thumb, and above 3 Inches long; and ſome live ſo long, as to have fine Hair, thinly diſperſed over their Bodies.

The ingenious Gentleman who ſent it me is of Opinion, that the Animal is indeed Pernicious, if eaten by a Beaſt. For firſt, the Diſeaſe, imputed to this Creature, ſeldom or never affects the Cattle but in Autumn, and then, only this Inſect is to be found; *Secondly*, it ſeldom or never attends any Cattle but what feed in low marſhy Grounds, and there only this Animal frequents; *Thirdly*, Cows who are greedy Feeders by great Morſels (by reaſon of their Chewing it afterwards in their Cud) but eſpecially Swine that feed in low Grounds, are the only Creatures troubled by this Worm; *Fourthly*, the Worm is very rare, and ſcarce to be found in ſeven Years, and ſo likewiſe is the Diſtemper that proceeds from it; being rare to have a Beaſt affected by it. As to the *Symptoms* that attends its *Venom*, they are, ſwelling in the Head, and (as a peculiar Characteriſtick) the Swelling and *Procidentia Ani*, inſomuch that the *Rectum* will hang out above half a Foot. The Effectual Cure applied to this Malady in *Black Cattle*, is a Drench of the Herb *Bears-Foot*, *Rue*, *Garlick*, *Butter* and *Beer*; but for *Swine*, *Raddle*, pounded ſmall mingled with *Butter-Milk*. Theſe only are pounded by *Engliſh* Huſbandmen. But the *Iriſh*, as they certainly impute the Malady to this *Inſect*, ſo they draw the Remedy therefrom: For they aſſert, that if a Hole be bored in a Tree, and this Creature ſtopt up therein, ſo as to ſtarve and die, the Leaves and Bark of that Tree, ever after, infuſed in Water, and given as a Drench, Cures the affected beaſt; and ſeveral will repair to ſuch a *Tree*, 10 Miles for a Cure. Another Fancy (and as ill-grounded) they have, that if a Man bruiſe this Worm between his Hands, and let the expreſſed Juice dry thereon; ever after the Water he firſt Waſhes in the Morning, given to the Beaſt to Drink, Cures it.

But I am very apt to ſuſpect, That this Worm is no more Poiſon than other Caterpillars. But the Uglineſs of the Worm (it being of a Dark, Fuſcous, and as they ſay, Poiſonous Colour) together with its largeneſs beyond Common Caterpillars, has wrought ſo upon the fearful and ignorant Vulgar People, that they have given it the Name of *Venomous*. Yet I will not conceal, what I have from another Gentleman (but with ſome Diffidence of the Experiment) he gave the Juice of one of the Worms to one Dog, which ſhewed no Alteration thereon, but another Dog, to whom he gave the *Skin* of the Creature, was found dead three Days after.

But whether his Death proceeded from the Poiſonous Skin, he could not aſſert; for the *Dog* ran at Liberty, and might have been killed (for ought as he knew) by ſome other Accident; tho' no external Sign of any Violence offered to him did appear.

Fig. 181 AB, is the *Worm* lying on its Belly, long two Inches and half almoſt; *c*, his Head; *dd*, two *Variegated Spots*, miſtaken by the People of our Country for *Eyes*; *e*, a ſmall Protuberance towards its Tail, from whence ariſes a Part in ſhape of a Horn, miſtaken for a Sting.

Fig. 182 *Fig.* 182, Repreſents the Worm reclined almoſt on his back; *F*, his Mouth formed like that of other *Caterpillars*, as it appeared in the *Microſcope*; *ggg*, Six ſmall *Horny Feet* or *Claws*, three on each Side, as in other *Caterpillars*; *hh*, *Eight Papillæ*, with which he faſtens himſelf to what he goes or hangs on, as Childrens Suckers are faſtened to Wet-Stones; *ii*, two larger *Papillæ*, with which he does both ſuck himſelf faſt, and moſt commonly therewith he graſps the Stems of Graſs and Herbs, to which he clings with the other.

The true Origin of Caterpillars; By Dr. Geo. Garden, *n.* 237 *p.* 54.

IV. The Bearers of Fruit-Trees are full of Aſperities, and not ſo ſmooth in their Bark as the other Parts of the Tree. If after the Harveſt, and any Time all the Winter over, you look upon theſe Bearers, through an ordinary *Microſcope*, you will find the Cavities there full of Eggs, of an oblong Figure, and *Citron-Colour*, eſpecially in thoſe Years and Trees, wherein the *Caterpillars* have been numerous: Out of theſe they are Hatch'd in the Spring. The Seaſons which uſually deſtroy them are, when there comes early Heat, ſuch as is ſufficient to Hatch them, before the coming forth of the Buds and Bloſſoms, and when immediately there ſucceeds a Nipping Froſty Air, which ſoon kills them.

The Generation of Inſects.

The Diſcovery of this Manner of their Propagation, ſeems to give light to theſe Conjectures. 1. That we ought not to conclude, that any *Inſects* are Bred of Corruption, and not *Ex Ovo*; becauſe we cannot diſcern the particular manner of their Propagation: For the diſcovery of this you ſee is by Accident, and not diſcernable by the naked *Eye*. 2. That the *Female Inſects* of all kinds of *Flies* and *Butterflies* do probably put their *Spawn* near thoſe Places where the *Eruca's*, which are Hatch'd of them, are to have their Food:

Vid. Inf. §. IX.

So that they are to be ſearched for in ſuch Places, by thoſe who enquire into the Manner of their *Propagation*. 3. They ſeem to be fixed into the Cavities of the *Bearers* by a *Gluten*, ſo as that Rains do not waſh them off. 4. The greateſt *Froſts*, it ſeems, do no Hurt to the ſmall *Eggs* of *Inſects*; for I have ſeen the *Caterpillars Hatch*, after moſt *Cold* and *Froſty Winters*, of thoſe *Eggs* which I have obſerved on the *Bearers* all the *Winter* over.

Obſervations on a Glow-Worm, *by* *Mr.* J. Templer, n. 72. p. 2177.

V. *May* 27. 1671. I put a *Glow-Worm* into a ſmall thin Box (ſuch as Pills are ſent in) between 11 and 12 at Night, I ſaw her Shine, through the Box, very clearly on one ſide, the Box ſhut; putting white Paper in the Box, and the *Worm* into the Paper, it ſhined through the Paper and Box both.

28. In the Morning about 8 of the Clock, ſhe ſeemed *Dead*; and holding her in a very dark place, I could perceive but very little Light, and that only when ſhe was turned upon her Back, and by Conſequence put into ſome little *voluntary Motion*. After Sun-ſet that Night, ſhe walked briſkly up and down in her Box, ſhining as clearly as the Night before; and that, when there was ſo much Day-light, that I could read without a Candle.

29. In the Morning ſhe ſeemed dead again; at Night recovered herſelf, and ſhined as well as ever, through the Box; and holding a large Candle in my Hand, the Light of it did not ſenſibly diminiſh that of the *Glow-Worm*.

30. 10. *h. v.* I ſet the Box with the *Worm* in it, about 4 Yards from me, in a Window, where I perceived it ſhine through the Box, for almoſt an Hour.

31. 4. *h. m.* I found it ſhining, and obſerved it in plain Day-Light, for about half an Hour, and then wholly ceaſing. At 5 in the *Evening*, the *Worm ſhined* pretty clear, in a very lightſome Room; at which time the Sun ſhined gloriouſly into the Room. Some time after ſhe ſhined little, having contracted her Body into a bending Poſture, the Light ſcarcely ſo big as a great Pin's Head: But upon touching of her, ſhe extended herſelf, walked in her Box, and at firſt extent ſhined as gloriouſly as ever.

N. B. I never ſaw her ſhine without ſome ſenſible Motion, either in her Body or Legs; in her cleareſt Shining ſhe extends her Body a third part beyond its uſual Length; and, if my Senſes fail me not, ſhe emits a ſenſible Heat in her clear ſhining.

n. 8. p. 3035.

June 1. Upon ſeveral Trials of Different Poſitions, I find her not to ſhine ſometimes when in Motion: But I could never yet ſee her ſhine, when not in Motion of ſome part.

June 8. Putting her into an *Urinal* of *white Glaſs*, at 9 a Clock at Night, ſhe crawled nimbly into it, and extended herſelf beyond an ordinary Length, yet her ſhining was not ſo clear, as in her Box when opened. Putting the *Urinal* into the *Water* for about half an Hour, it gave a very delightful *Irradiation* of the *Water*. When this Light ſeemed wholly *extinct*, although it was in Motion, if I depreſſed the *Urinal* into the Water, till the Bottom almoſt touched the Bottom of the Baſon, I could (upon looking in at the top of the *Urinal*) ſee a very fair Light; but upon lifting the Glaſs out of the Water, I could diſcern very little *ſhining*. Then putting her into her Box, ſhe did in about a Minute's time (for I tried it twice over, by a Watch) almoſt ten times increaſe her former ſhining in the *Urinal*.

14. The *Worm* ſeemed dead; and being ſhut in a Box, would give no Light, though it was betwixt 9 and 12 a-Clock at Night: But in the uncovered Box, or in the Urinal, ſhe did ſhine faintly, and the Light was of a far different Colour from what it was formerly.

15. I touched her with a Needle gently, whereupon ſhe ſtretched out one of her Legs, and by it, when I inclined the Poſition of the Box, ſhe ſtayed her whole Body from falling. Before I pricked her, ſhe did give a little ſhining in her uncovered Box, but none through the Urinal: Only if you looked in at Top, a little Shining was ſeen: Upon pricking her, I did not ſee her ſhining increaſed.

16. I diſcerned a little Shining only within her Box: Upon Pricking I could diſcern no Motion in her; but the Scale next her Tail, was ſenſibly more extended a quarter of an Hour after I pricked her, than before.

N. B. The three laſt Days, ſhe lay continually upon her Back, with her Legs contracted, except only the time mentioned *June* 15, of my pricking her. I am afraid to conclude her dead, *June* 16, having been informed by Mr. *Th. Halleback* of *Cald-Newton* near *Melton-Mawbury*, that he kept a *Glow-Worm* near ſix Months in his Parlour-Window, which would ſometimes ſeem dead for many Days together (if I miſtake not, he ſaid Weeks) and afterwards both walk and ſhine again.

The Flying Glow-worm by Mr. Rich. Waller, n. 176. p. 841.

VI. The *Cicindela Volans*, or *Flying Glow-Worm*, is very rare in *England*; yet I have happened to catch of them twice at *Northaw* in *Hertfordſhire*: Firſt, about *Midſummer* 1680, and for a Fortnight in *June* 1684. They flew about the Candle as ſoon as it grew dark; at both which times, the Weather was very hot; and, it may be, it ſhines only at ſuch Seaſons, though the Animal be eaſie enough to be met withal Winged, when it ſhines not, and without Wings ſhining, which is the *common Glow-worm*.

Lib. 4. c. 8. c. 11. p. 108. De Luce Animalium. Lib. 2. c. 22.

The Deſcription of it by *Aldrovandus* agrees very well with the Animal: But both *Mouſet* and *Tho. Bartholin* are miſtaken, in allowing the Male only to have Wings. The contrary was known to *Julius Scaliger*: And I once caught the Male and Female coupled, and could obſerve no difference between them, except in Size (the Female being a little the larger) for they both ſhined alike. Its light was very Vivid, ſo as to be ſeen plainly when a Candle was in the Room; but the Vibrations thereof were unequal, and the Colour greeniſh, like that of the *Creeping Glow-Worm*. The Luminous Part was too ſmall Specks on the under-ſide of the Tail, at its End. The Shining continued for a little while after the *Tail* was cut off, tho' it ſenſibly decayed, till at laſt it went quite out. Poſſibly, the Uſe of this Light is, to be a Lanthorn to the Inſect in catching its Prey; and to direct its courſe by, in the Night: Which is made probable, by the Poſition of it on the upper Part of the Tail; ſo that by bending the ſame downward (as I always obſerved it to do) it gives a Light forward upon the Prey or Objects, the Luminous Rays, in the mean time, not being at all incommodious to its Sight, as they would have been, if this Torch had been carried before it. The Conjecture is alſo favour'd by the placing of the Eyes, which are on the under Part of the Head, not on the Top. I obſerved alſo, that it could, and did, by ſome Contrivance, cover its Light, and make a kind of Dark Lanthorn.

Fig. 183. Shews the Inſect upon its Feet, with the Back upwards; where *Fig.*183. it appears to be of the *Beetle*-kind. It is of a dark-brown Colour, unpoliſh'd: When the Caſe-Wings are open'd, it extends two very large Membranous Wings, faſten'd to the upper part of the *Thorax*. Its Head is cover'd, as it were, with a Shield, or broad-brimm'd Hat.

Fig. 184. Repreſents it laid on the Back, to ſhew the two Eyes under *Fig.*184. the broad Covering. They are black, and very large, making almoſt the whole Head; there being little elſe to be ſeen. Theſe are moveable, ſo that the Animal can thruſt them forward to the Edge of its Hat. From between theſe, are diſcovered two Hairy Feelers, or perhaps Bruſhes to cleanſe the Eyes. Between theſe Eyes and the *Thorax* lies the Mouth. On the *Thorax* are ſix Legs, almoſt all of a length. The Tail is made of ſeven ſhelly Rings; at the laſt of which are viſible, two ſhining Points.

Fig. 185. Shews the Inſect on its Back, as it was ſeen through a Mi- *Fig.*185. croſcope when dead; where *A A* repreſents the two long Horns, Feelers or Bruſhes, conſiſting of ten Roundiſh Joints, beſides the firſt, which is as long as Two of the reſt: They are all Hairy, and like thoſe of ſome Butterflies; for all have them not. B B The broad Covering, or Hat, over the Head, which ſhewed of a Speckled Brown, and Yellowiſh Colour, like Tortoiſe-ſhell. *C C* The Two Eyes compos'd of Innumerable ſmall Glaſſy Hemiſpheres in Rows; as hath been obſerv'd by the ingenious Mr. *Hook*, in his *Micrography*, to be the Make of the Inſect's Eyes, ſo to ſupply the Defect of Motion in their Eyes, by the Number of *Pupilla's*. I have ſeen theſe Spherical Bodies in the Eyes of ſome Butterflies, ſet in Circles, not in Rows, with long Hairs growing out of each ſpace, left by the Connexion of the Hemiſpheres. *D D D D D D* The Legs, of a Shelly Make like *Lobſters*, and ſo Jointed. As well in this as other Flies, they are covered with many ſtiff Hairs, though not ſo full as thoſe of the Blue Fly, Figured by Mr. *Hook*. The Mechaniſm of the Feet, as I take it, are much the ſame; Microg. Sch. 26. only what is there called the *Pattens*, were here wanting (if not broken off, as I believe they were not) and their Uſe ſupplied by the Gibbous Part, repreſented by *d d d*. The Talons *e e e e e e* of the Feet were ſhining, and very ſharp-pointed. The Legs were of Two long Joints, and the Feet of Four more, beſides that which was armed with the Talons. Theſe ſeem'd to be Jointed one into another, and were all thick beſet with Hairs or Briſtles. *E* the *Thorax* of but one Shell, of a poliſh'd Copper-Colour, ſtuck full of Tapering Briſtles, a ſmall Dent being diſcernable in the Shell wherein each grew. *F*, the Tail, conſiſting of 7 Rings of the ſame browniſh Colour; without Hairs, except on their Edges, which were ſet with them like a thin Fringe, as the Tails of *Lobſters*, *&c.* are. Theſe Rings were of an unequal ſhining Shell-Colour. *f f*, The Back or upper Part, of two or three Rings of the Tail, turned up to ſhew the Work of the Shell on that ſide. On the Inſide of the laſt of theſe was the Light placed, though there was now nothing to be ſeen, except that Part being a little lighter coloured than the reſt of the Tail. *G G G*, the membranous Wings, in every particular like thoſe of the Blue Fly, with Hairs upon the Veins, or Quilly Parts. *H H*, the Inſide of the Caſe-Wings, which were Hairy, pointing all downward; the Outſide of theſe Caſes is alſo very Briſtly.

An odd ſort of Maggots *by Dr.* M. Liſter, *n.* 160. *p.* 595.

VII. In the Harveſt-time, 1666, the Sickneſs then raging at *Cambridge*, at *Baſſenbourn* in *Cambridgeſhire* there were Millions of *Maggots* on the Corn-Lands; and in their Barns too, the Floor would be cover'd with them that fell from the Carts. The *Maggots* were about half an Inch long, no thicker than a Pidgeon's Feather, of a white Colour, ſomewhat ſhaded with an *Iſabella*, or faint yellowiſh Stripes, the length of the Worm; they had 14 Feet, after the manner of many Caterpillars, and I was almoſt confident, would have produc'd ſome ſort of *Moth*. I took up about a Score of them, and put them into a Box; but they immediately offended me with an ungrateful and ſtrong Stink, which yet is not uſual to the Caterpillar-kind. After two Days, I rid myſelf of them; and only obſerv'd, that the Excrements which they voided, were little hard Pellets of pure white Flour, like that of *Barley*.

Swarms of ſtrange and miſchievous Inſects in N. England, *by* — *n.* 8. *p.* 137.

VIII. Some few Years ſince there was ſuch a Swarm of a certain ſort of Inſects in *New-England*, that for the ſpace of two hundred Miles they poiſoned and deſtroy'd all the Trees of the Country, there being found innumerable little Holes in the Ground, out of which thoſe Inſects broke forth in the form of Maggots, which turned into Flies that had a kind of Tail, or Sting, which they ſtuck into the Tree, and thereby Envenom'd and kill'd it.

The Libella, *by* M. Poupart, *n.* 265. *p.* 673.

IX. The *Libella* is a Flying Inſect, called in *France*, *Demoiſelle*, from the Variety of its Colours, Tranſparency of its Wings, and its ſtately Flight. They alſo call it *Pearle*, from the Figure of its Head, or rather from the Roundneſs and Colour of its Eyes. It is divided from ſpace to ſpace into Rings, by means of which it compoſes Angles with its Body, whoſe Lines it can make longer or ſhorter, as it finds occaſion.

Theſe different Sections ſerve to the Motion of this Inſect, as we know the Tail doth in Birds; and as they are Lengthen'd or Contracted, they carry themſelves according to their various Inclinations, the Point or Center being fixed between their Wings. All Modern Naturaliſts know, the greater ſort of *Libellæ* are generated under Water, wrapt up in a Membrane, which at length diſſolves, and turns to nothing.

When the young *Libella* is ready to quit its Caſe, it dilates its Belly, that the Water may enter in at the *Anus* upon the *Inteſtines*; then it compreſſes itſelf to circulate the Water, which it expels, and ſhoots out a great way. It receives more Water into its *Inteſtines*, and ejects it after the ſame manner. It continues this Action with great Force for ſome time, and makes the Water circulate in the Veſſel.

To ſatisfy myſelf that it took the Water in at the *Anus*, and not at the Mouth, I put a *Libella* upon my Finger, which I held faſt by the Legs; I dipt it under Water with its Head downwards, the *Anus* being even with the Water, ſo that it might get into the *Inteſtines*, which it caſt out a good way. I drew my Finger a little further out, ſo that the Water could not enter at the *Anus*; and the Fly continued its Motion, but ejected no Water. My Opinion is, ſhe does this, in order to cleanſe herſelf from all Excrements in that Element, where ſhe leaves her old Robes, to appear in a more glorious and new Form in the open Air.

There are a great Number of ſmall Veſſels which cloſely unite the Body of the *Libella* to its Caſe: It is neceſſary that theſe be dry, that they may the ſooner break when it makes its Efforts to get out of its Caſe, which cannot come to paſs as long as there is any Aliment in the *Inteſtine* to afford Nouriſhment to the Caſe, and its Strings. And perhaps this is the Reaſon, why no Inſects will take any Food, when they are going to change their Forms: And if they do not cleanſe themſelves, as the *Libella*'s do, yet they ſtay a great while longer, before they change, without any Aliment; the *Libella* is no longer than half a Day in quitting its Caſe, and taking its Flight.

To know the Cauſe of its exceeding ſwift and whirling Motion, we muſt cut the Skin of the *Libella*, which is very fine, all along the Back, and be ſure to bear the Point of the Scizzars upwards, leſt we cut the Interiour Parts. We muſt alſo draw the Skin to the Right and Left Hand, and fix it with Pins upon a Table, that we may diſcover the 16 Muſcles, which lie between the Wings and Legs (Eight on each ſide) of the Thickneſs, Length, Colour, and almoſt Figure or Shape of a Grain of Barley, contiguous to one another, and without Adherence. We may obſerve, that each Muſcle is compoſed of many Fleſhy Fibres, which do not ſeem to be joined together, but terminate round at the Ends of the Muſcle, where they compoſe a common Tendon; ſo that one might diſcern any of theſe Fibres to be a ſmall Muſcle, of which the Chief is compoſed. The Uſe of theſe Muſcles ſeem to me very particular: For the ſame Muſcles which flutter the Wings, ſerve alſo to ſtir the Legs. The Upper Tendons of the Muſcles enter into the Wings, I believe the ſame which the Fibres compoſe; and the lower enter a good way into the Legs; yet the contrary Motions of theſe Organs are not at all hinder'd; for as long as the Wings play, the Feet lie ſtill, and ſerve for a Prop to the Muſcles which ſtir the Wings; and when the Feet are in Action, the Wings are quiet, and in their Turn ſerve to ſupport the Tendons which direct the Feet.

The Eyes are like two oblong thick Pearls, which begin at the Fore-part of the Head, and end in the Hinder-part; their outward Membrane is dry, thin, tranſparent, and encloſes a ſmall ſoft Ball, filled with a very black Liquor; two ſmall Canals fill'd with Air, enter into each of theſe Eyes, and run along to the great Channel, alſo furniſhed with Air; which accompanies the *Inteſtine* from the Head to the Tail. This Structure made me think, that the *Libella* could derive the Air contained in theſe Canals into the Eyes, to give it a greater Convexity to behold Objects that are very near: And on the contrary, the Air is forced out of the Eyes again, to flatten them, when they look at remote Objects. And my Conjecture is not altogether frivolous; for having blown into the thick Canals, which are about the middle of the Body, the Eyes became conſiderably tumified; and by letting the Air return, they became flat again. If we leave a *Libella* dead for ſome Days, the inward Parts will putrify, and come to nothing: But theſe Canals will remain entire, and as ſolid and firm as they were before.

Of ſpontaneous Generation, by Mr. Ray, *n.* 74. *p.* 2219.

X. Whether there be any Spontaneous, or Anomalous Generation of Animals, as hath been the conſtant Opinion of *Naturaliſts* heretofore, I think, there is good Reaſon to queſtion. It ſeems to me at preſent moſt probable, that there is no ſuch thing, but that even all *Inſects* are the natural Iſſue of Parents of the ſame Species with themſelves.

Gener. degl' inſetti.

Fr. Redi hath gone a good way in proving this; having cleared the Point concerning Generation *ex Materia Putrida*. But ſtill there remain two great Difficulties: The Firſt is, to give an Account of the Production of *Inſects*, bred in the By-Fruits and Excreſcences of *Vegetables*, which the ſaid *Redi* doubts not to aſcribe to the Vegetative Soul of the Plant that yields thoſe Excreſcences: But for this I refer you to Mr. *Liſter*. The Second is, to render an Account of *Inſects* bred in the Bodies of other Animals.

The Grain of Kermes, *its Uſe, and the Fly formed out of it, by M.* Verney, *n.* 20. *p.* 362.

XI. 1. M. *Verney*, a *French* Apothecary at *Montpelier*, having deſcribed the Grain of *Kermes* to be an Excreſence growing upon Wood, and often upon the Leaves of a Shrub, plentiful in *Languedock*, and gathered in the End of *May*, and the Beginning of *June*, full of a red Juice; ſubjoins two Uſes which that Grain hath; the one for Medicine, the other for dying of Wool. For the latter Uſe, they take the Grain of *Kermes*, when ripe, and ſpread it upon Linen; and at firſt, whilſt it abounds moſt in Moiſture, 'tis turned twice or thrice a Day, to prevent its Heating; and when there appears red Powder amongſt it, they ſeparate it, paſſing it thro' a Searce; and then again, they ſpread abroad the Grain upon the Linen, until there be perceived the ſame Redneſs of the Powder; and at the end, this red Powder appears about, and on, the Surface of the Grain, which is ſtill to be paſſed through a Searce, till it render no more.

In the Beginning, when the ſmall red Grains are ſeen to move, as they will do, they are ſprinkl'd over with ſtrong Vinegar, and rubb'd between ones Hand. If this red Powder ſhould be let alone, without pouring Vinegar, or ſome other acid Liquor upon it, out of every Grain there would be formed a little Fly, which would ſkip and fly up and down for a Day or two, and at laſt changing its Colour, fall down quite dead, depriv'd of all the Bitterneſs, the Grain, whence they are generated, had before.

The Grain being altogether emptied of its Pulp or red Powder, 'tis waſh'd in Wine, and then expos'd to the Sun; being well dried, 'tis rubb'd in a Sack to render it bright, and then 'tis put up in ſmall Sacks, putting in the midſt, according to the Quantity the Grain has afforded, 10 or 12 Pounds (for a Quintal) of the Duſt, which is the red Powder, that came out of it. And accordingly, as the Grain affords more or leſs of the ſaid Powder, Dyers buy more or leſs of it.

'Tis to be noted, that the firſt red Powder which appears, iſſues out of the Hole of the Grain, that is on the ſide, where the Grain adher'd to the Plant, and that that, which about the end appears ſticking on the Grain, hath been alive in the Huſk, having pierc'd its Cover; tho' the Hole whence it commonly iſſues, remains cloſe, as to the Eye.

The Inſect-Huſks of the Kermes-kind, by Dr. M. Liſter, *n.* 71. *p.* 2165. *n.* 72. *p.* 2177.

2. Some Years ago, I gather'd off our *Engliſh Oak*, round Worm-Huſks, very like *Kermes*-Berries; and I have often obſerv'd on *Plumb*-Trees and *Cherry*-Trees, alſo on the *Vine* and *Cherry-Laurel*, certain *Patellæ* or flat Huſks, containing Worms, which (or at leaſt the Huſks) will ſtrike a *Carnation* with *Ly* and *Stand*. In *May* 1671, I obſerved the ſame *Patellæ*, or Huſks, indifferently on Vine-Branches, Cherry-Laurel, Roſe-Buſhes, Plumb-Trees, and the Cherry-Tree. The Figure of the Huſk is round, ſave where it cleaved to the Branch; for bigneſs, ſomewhat more than half a Gray-Pea: Theſe, I ſay, cleave to their Branches, as *Patellæ* do to Rocks; for Colour, they are of a very dark Cheſnut, extremely ſmooth, and ſhining Membrane-like. They adhere moſt commonly to the under-ſide of a Branch or Twig; and ſo are beſt ſecured againſt the Injuries of the Weather, as too much Sun and Rain. They are well faſten'd to the Branches ſingle, and ſometimes many in Company. They are ſeldom found without Vermin, as *Piſmires*, *&c.* which I gueſs, pierce them, and prey upon them. If you cut off dextrouſly the top of the Huſk with a Razor, you'll find ſometimes 5 or more ſmall white Maggots, of the *Waſp* or *Bee*-kind; that is, ſharp at both Ends. If when you have cleared the Huſk, you rub the empty Membrane upon white Paper, it will freely and copiouſly tinge the Paper with a beautiful Purple, or *Murrey*.

n. 73. *p.* 2196. *n.* 76. *p.* 2294.

Jan. 10, 1671, I found ſeveral of theſe *Patellæ Kermiformes* hatch'd in a Box, where I had purpoſely put them; they prove a ſort of Bees: But certainly, the leaſt that ever I yet ſaw of that Tribe, as not much exceeding in their whole Bulk the half of a Piſmire. They are very compact and thick for the Bigneſs, of a Coal-black Colour. There is a remarkable Spot on their Backs, white, or Straw-colour, large and round. The upper part of their Wings are ſhaded, or dark-ſpotted, the undermoſt Pair are clear. We may entitle them, according to our Cuſtom, *Apeculæ Nigræ, macula ſuper Humeros ſubflavescente*

veſcente inſignitæ, è patellis ſive Favis membranaceis, veri Kermes, ſimilibus, ſuaque itidem purpura tingentibus, Ceraſi aut Roſæ aliarumve Arborum Virgis adtextis, excluſæ.

It is to be further obſerved,

1. That thoſe that look the blackeſt, yield the deepeſt and beſt Purple.

2. That as the Bees come to Maturity, the Dye ſeems to be ſpent, and the Huſks grow dry.

3. That the young ones make their Way out at ſeveral ſmall Holes, that Hole in ſome of the Shop-*Kermes*, being accidental only, and ever on the bottom-part cleaving to the Branch, and the Time of gathering them for Colour, is, without doubt, before they are pierced, and whilſt the Animal is yet *in Vermiculo*, and conſequently the Huſk entire.

We compar'd theſe Purple *Kermes* with the Scarlet *Kermes* or Grains of the Shops, and found them in every Point to agree, ſave in the Colour of their Juices; and particularly (finding in ſome Parcels of the Shops many yet ſticking to little Twigs of the *Ilex)* we confidently affirm, that thoſe, as well as ours, are only contiguous to the *Ilex*-Branches, and are not Excreſcences of the Tree, much leſs, Fruit or Berries, by which abuſive Names they have been too long known; but that they are the Artifice and ſole Work of the Mother-Bee, in order to the more convenient Hiving and Nouriſhment of her Young.

Theſe things alſo are certain, *viz.*

1. That we have ſeen the very Gum of the *Apricock* and *Cherry-Laurel*-Trees tranſudated, at leaſt, ſtanding in a Chryſtal Drop, upon ſome, though very rarely, of the Tops of theſe *Kermes.*

2. That they change Colour, from a Yellow to a dark Brown, and that they ſeem to be diſtended, and to wax greater, and from ſoft to become brittle.

3. That they are filled with a ſort of *Mites*, concerning which I am pretty well aſſured by my own, and alſo by Dr. *Johnſon* of *Pomfret*'s more accurate *Microſcopical Obſervations.*

4. That the *Bee-Grubs* actually feed on *Mites*; there being no other Food for them.

5. That there are other Species of *Bees* or *Waſps*, beſides thoſe by me deſcribed, which are ſometimes found to make theſe Mites their Food, Dr. *Johnſon* having opened one Huſk, with only one large Maggot in it.

6. That there are probably different ſorts of *Mites* in theſe Huſks making poſſibly different Species of *Kermes:* For ſome I have found to hold *Carnation-coloured Mites* encloſed in a fine white Cotton, the whole Huſk ſtarting from the Twig, ſhrivelling up, and ſerving only for a Cap or Cover to that Company of Mites. Other Mites I have ſeen white, and, which is moſt uſual, the Huſks continuing entire, and not coming away from the Twig they adhere to, and but little Cotton at the bottom.

7. That the ſhrivell'd Cap, to be found upon the Mites encloſed in the Cotton, as alſo the whole Huſk itſelf, if taken early in *April*, while ſoft,

will (dried in the Sun) ſhrink into the very Figure of *Cochineel:* Whence we gueſs, that *Cochineel* may be a ſort of *Kermes*, taken thus early, and Sun-dried.

I conceive, that the ſmall Scarlet-Powder, mentioned by Mr. *Verney*, is to be underſtood of thoſe Mites, and that they are to be diſtinguiſh'd from the Bee-Grubs, which are changed into the Skipping Fly; that is, the *Bee*, for Kind at leaſt, here deſcrib'd by us.

Obſervations on Vegetable Excreſcences and Inſects generated in them, by Dr. M. Liſter, n.75.p.2256

XII. 1. The Account I have given of the *Purple Kermes*, both gives a clear Light to the Diſcovery of the Nature of the *Scarlet Kermes*, a Thing wholly unknown to the Ancients; and alſo, is an evident Inſtance, that ſome Things confidently believed Vegetable Excreſcences, are no ſuch matter; but Artificial Things, meerly contiguous to the Plant, and which have no other relation to it, than the *Patella* Shell-Fiſh to the Rock it cleaves to.

2. Generally, *Inſects Eggs* laid upon the Leaves of Plants, their reſpective Worms feeding on them, do not occaſion, or raiſe Excreſcences. n.76.p.2284

Thus, for Example, the *Eggs* of the common Red *Butterfly*, laid upon the *Nettle*, are thereon hatched, without bliſtering the Plant into an Excreſcence; and the ſtiff-haired, or prickly *Caterpillars*, hatched from theſe Eggs, feed upon the Leaves, without any ill Impreſſion, Puncture, or Prejudice, ſave that they make clean Work, and eat all before them. n.77.p.3003

3. Some *Inſect-Eggs* laid upon the Leaves, or other Part of Plants, do as ſoon as hatch'd, pierce and enter within the Plant to feed. I had a convincing Inſtance to the Truth of this Propoſition.

May 22, 1671, When I obſerved on the Back or Under-ſide of the Leaves of *Atriplex Olida*, certain ſmall Milk-white oblong Eggs; on ſome Leaves 4, on others fewer, or more. Theſe Eggs were on ſome Plants yet unhatch'd, but on many of the ſame Plants I found the Egg-ſhells or Skins yet adhering to the Leaves, and the little Maggots already enter'd, through I know not what inviſible Holes, within the two Membranes of the Leaf, and feeding on the inward Pulp or Subſtance of the Leaf; in other Leaves of that Plant I found thoſe Maggots grown very great, and yet the two Membranes, that is, the uppermoſt and undermoſt Skin of the Leaf entire, but raiſed and hollow like a Bladder. *Note*, 1. That thoſe Maggots were of a Conick Shape. 2. That in *July* they ſhrunk into *Fly Chryſali's*, and accordingly came to Perfection: And to this unobvious way of Feeding we think we may refer all Worm-eaten Fruits, Woods, *&c.*

4. *Worms* feeding within ſome of the Parts of ſome Plants, do cauſe Excreſcences. Thus the *Heads* or *Seed-Veſſels* of *Papaver*, *Spart. Sylv. Emat.* &c. are disfigured for having *Worms* in them, and grow thrice as big as the not ſeiſed ones. This is alſo plain in the Excreſcences of *Pſeudo-Teucrium* and *Barbarea*.

5. The Subſtance or Fibrous Part of many vegetable Excreſcences ſeems not to be the Food of the *Worms* found in them; that is, the *Worms* in thoſe vegetable Excreſcences which produce *Ichneumons* (to which kind of *Inſect* we would limit this Propoſition) do not ſeem to devour the Subſtance or Fi-

Fibrous Part of them, as other Worms eat the Kernels of Nuts, *&c.* But whatever their manner of Feeding is (and we doubt not but they are nouriſh'd in and upon ſome part of them) the Vegetable Excreſcences ſtill mightily increaſe in Bulk, and riſe as the Worms feed. And it is obſervable (to endeavour a Solution) that ſome of the *Ichneumons* delight to feed on a Liquid Matter, as the Eggs of Spiders, and the Juices, if not Eggs, within the Bodies of Caterpillars and Maggots. Whence we conjecture, that thoſe of the ſame Genus to be found in *Vegetable Excreſcences,* may in like manner ſuck in the Juices of the equivalent Parts of Vegetables. And this the dry and ſpongy Texture of ſome of thoſe kind of Excreſcences ſeem to evince. For if you cut in pieces a *Wild Poppy*-Head, for Example (or the great and ſoft Balls of the *Oak)* you will find in thoſe Partitions, wherein theſe Worms are lodg'd, nothing but a pithy Subſtance, like that of *Young Elder*; and if there chance to be any Cells yet unſeiz'd, which I have ſometimes obſerv'd, the Seeds therein will be found yet entire and ripe; whence 'tis very probable, that they feed upon, and ſuck in by little and little, the yet liquid Pulp of the tender Seeds, and leave the Subſtance, or Fibrous Part, to be expanded into an *Excreſcence.*

Vide infra, §. XIV.

The Gall-Bee, by Mr. Ben. Allen, *n.*245.*p.*375.

XIII. In ſome *Aleppo-Galls,* which the Inſects had not eat their Way out of, I found a ſort of *Bee* reſembling the ſmall ſort of our *wild Bees*; they have long Wings, a deep Belly, and on the Back, near the Commiſure to the Body, it is of a *greeniſh Black,* the reſt reddiſh, near a *Cinnamon-Colour.*

Theſe *Galls* are very gummy, and the Cavity round them was ſo extremely gummy, that not the leaſt Room or Entrance of it appear'd, tho' the Bee was beginning to making its way out. Some of the *Galls* had a Stem to them, and may give ſome Light to the Reaſon of Life, that the Atmoſpherical Air is not neceſſary to the Eſſence, before the Organs of the Body are employ'd; but that that is maintain'd by a ſubtler Air, that pervades more minute Pores, as it is convey'd to Fiſh through the Water.

I have alſo found in the greyer ſort of *Gall,* not ſo rich in Gum, a ſmall *Ichneumon* of a bright Green.

Ichneumon-*Waſps, and the manner of laying their Eggs in the Bodies of Caterpillars, by Mr.* Fran. Willoughby, *n.*76.*p.*2279.

XIV. 1. As I remember, Mr. *Liſter*'s Opinion is, that the *Muſcæ Ichneumones* lay their Eggs in the Bodies of Caterpillars; which I look upon as very ingenious and true. Theſe *Ichneumones* have all four Wings, *Antennæ,* like Bees; their Body hanging to their Breaſt by a ſlender Ligament, as in *Waſps*; moſt, if not all, had Stings, and are made of a Maggot, that ſpins herſelf a *Theca* before ſhe turns into a *Nympha.* There is great Variety of them, ſome breed as Bees do, laying an Egg, which produceth a Maggot, which they feed till it comes to its full Growth: Others, as we gueſs, thruſt their Eggs into Plants, the Bodies of living Caterpillars, Maggots, *&c.* For, it is very ſurprizing to obſerve, that a great Caterpillar inſtead of being chang'd into a Butterfly, according to the uſual Courſe of Nature, ſhould produce ſometimes one, ſometimes 2 or 3, and ſometimes a whole Swarm of *Ichneumones.* I have obſerved this Anomalous Production in a great many ſorts of Caterpillars, both hairy and ſmooth in ſeveral ſorts of Maggots, and, which is moſt ſtrange, in one Water-Inſect. When there come many of theſe *Ichneumon*-Maggots out of the Body of the ſame *Caterpillar*, they weave all their *Theca*'s together into one Bunch, which is ſometimes round, with a Web about it, juſt like a Bag of Spider's Eggs. But none of them feed upon the Spider's Eggs; but it is the Similitude of thoſe *Theca*'s conglobated together to the Eggs of Spiders, that hath occaſioned this Conjecture.

One of the green *Caterpillars*, common in the Heaths in the North, went ſo far on to her natural Change, that ſhe made herſelf up into a great brown *Theca* almoſt of the ſhape of a Bottle, which was filled with a Swarm of *Ichneumones*; and I have obſerved in one or two other ſorts, that from the very *Aurelia* itſelf hath come an *Ichneumon*; which is very odd, that the *Caterpillar*, ſtung and impregnated by the *Ichneumons*, ſhould be yet ſo far unhurt and unconcerned, as to make herſelf a *Theca*, and to be turned into an *Aurelia*.

I have often ſeen a great *Ichneumon* dragging a *Caterpillar* in the High-way. This Year, 1671, Mr. *Wray*, in company with another ingenious Neighbour, obſerved one halling a large green *Caterpillar*, much bigger than herſelf; which, after ſhe had drawn the length of a Pearch, ſhe laid down, and then takes out a little Pellet of Earth, with which ſhe had ſtopped the Mouth of the Hole, like a Worm-hole; then ſhe goes down into it, and ſtaying a very little,' comes up again, and draws the *Eruca* down with her into the Hole, and there leaves her; and afterwards not only ſtops, but fills up the Hole, ſometimes carrying in little Clods, and ſometimes ſcraping Duſt with her Feet, and throwing it backwards into the Hole, going down after it herſelf, to ram it cloſe. Once or twice ſhe flew up into a *Pine-Tree*, which grew juſt over her Hole, perhaps to fetch Cement. When the Hole was full, and even with the Superficies of the Ground about it, ſhe draws two *Pine-Tree*-Leaves, and lays them near the Mouth of the Hole, and flies away. Not taking notice that ſhe came any more in three or four Days, we digged for the *Caterpillar*, and found it pretty deep. I put it into a Box, expecting it would have produced an *Ichneumon*, but it dried away, and nothing came of it.

We lately obſerved a ſort of *Ichneumons*, or rather *Veſpæ*, which prey upon ſeveral ſorts of Flies; when they fly with them, they hold them by the Heads, and carry them under their Bellies. Theſe make Holes a great depth in the Ground, in which they lay their young, and feed them with the Flies they catch, creeping backwards into the Ground, and drawing the Flies after them. I ſuſpect they may at firſt lay their Eggs in the very Body of a Fly; but one Fly being not enough to bring the young one to its full growth, they feed it with more. Their *Theca*'s are at laſt all covered over with the Wings, Legs, and others Fragments of Flies.

2 This kind of Inſect is one of the greateſt Puzzles in Nature, there being few Excreſcences of Plants, and very many Births of Inſects, wherein theſe ſlender Waſps, after divers ſtrange Ways are concerned.

By Dr. Liſter Ib. p. 2281, 2284.

'Tis true, the Swarms of theſe *Ichneumons*, coming out of the Sides of *Caterpillars*, do immediately make themſelves up into Bunches, and each particular *Theca*, from the *Cabbage-Caterpillar* (for Example) is wrought about with yellow Silk, as thoſe from the black and yellow *Jacobæa Caterpillar* with White: But as for Web to cover thoſe Bunches of *Theca*'s, I never obſerved it but in the *Green Caterpillars*, ſo common in our *Lincolnſhire* Heaths which are fixed to *Bents* or other Plants. Theſe, in truth, never but deceived my Expectation: For I verily thought, I had found, when I firſt obſerved them, a Caterpillar equivalent to the *Indian Silk-worm*; but having cut them in two, and expected to have found a Caterpillar's *Chryſallis* in the middle, there preſented themſelves a Swarm of *Ichneumons*. Theſe are as large, many of them, as my Thumb; that is, at leaſt, four times bigger than the *Folleculus* or Egg-Bag of any *Engliſh* Spider I ever ſaw yet. I have had them in ſeveral Boxes, ſome 8, ſome 10, ſome 12 Days *in Vermiculo*, feeding upon the very Cakes of Spiders Eggs, before they wrought themſelves *Theca*'s for further Change; and they ſeldom exceeded the Number of Five to one Cake of Eggs, &c. So that you may aſſure Mr. *Willoughby*, this is no Conjecture, but a real Obſervation.

*n.*77.*p.*3005. Concerning the Name 'Ιχνεύμων, I refer you to Mr. *Ray*, who is another *Heſychius*; and we have Obſervations enough to make us believe, that theſe very Inſects we have treated of, are, for kind, the *Ichneumones* of the Antients.

Hair-worms, by Dr. M. Liſter, n.832. p. 4064. XV. It hath been credibly reported, that Horſe-hairs thrown into Water will be animated; and yet I will ſhew you, by an unqueſtionable Obſervation, that ſuch things as are vulgarly thought animated Hairs, are very Inſects, nouriſhed within the Bodies of other Inſects, even as *Ichneumons* are within the Bodies of Caterpillars. I find many Particulars collected by the Induſtry of *Aldrovandus*, concerning this Inſect: But our own Obſervation is this:

April 2, 1672, There was thrown up out of the Ground of my Garden, a certain Cloal-black *Beetle* of a middle Size, and flat Shape, and which I have obſerved elſewhere common enough. I diſſected ſome of them, and was ſurprized to find in their ſwollen Bellies of theſe *Hair-worms*, in ſome three, in others but only one. Theſe Particulars we carefully noted:

1. That upon the Inciſion, they crawled forth of themſelves.

2. That putting them into Water, they lived in it many Days, and did ſeem to endeavour to eſcape, by lifting up their Heads out of the Water, and faſtening them to the ſides of the Veſſels; very plainly drawing the reſt of their Body forward.

3. That they cannot be ſaid to be *Amphiſbæna*; but do move forward only by the Head; which is fairly diſtinguiſhable from the Tail by a notable Blackneſs.

4. That the three I took out of the Body of one *Beetle*, were all of a dark Hair-colour with whitiſh Bellies, ſomewhat thicker than Hogs-Briſtles; but I took out of the Body of another *Beetle*, one that was much bigger than the reſt, much lighter coloured, and by meaſure juſt 5 Inches and half long, whereas all the reſt did not exceed 3 Inches and 3 quarters.

Some Obſervations about Bees, by Dr. George Garden, n. 175. p. 1157.

XVI. M. *Leewenhoek*, in 1673, took notice of five little Inſtruments, which are upon the Head of the Bee before; four whereof are two Pairs, the one being called by him *Scrapers*, the other *Arms*; the fifth he calls the *Wiper*, ſuppoſing that by it they wipe off the Honey from the Flowers. This laſt is truly the *Sucker* or *Proboſcis*, being hollow, and made up of all circular Fibres, wherewith the Bees ſuck the Honey from the Flowers.

The Globulets which break forth from the Attire of Flowers, deſcribed by Dr. *Grew* and *Malpighius*, which are for the moſt part of an oval Figure, and of different Colours, (ſome white, ſome yellow, ſome red) ſeem to be Bags of Liquors, and are the Materials which the Bees carry in for their Wax, as is evident, not only from the different Colours of the Wax upon their Legs, according to the different Colours of the Globulets of the reſpective Flowers we ſee them light upon; but for that alſo, if you take them gathering Wax from any particular Flower, and view a ſmall Parcel of that Wax with a Microſcope, you will find it to conſiſt of the Globulets of the ſame Flower; tho' it is not ſo eaſy to diſcover what Liquor they make uſe of, to cauſe them to ſtick together.

On the inner ſide of the hinder Legs of Bees, on the Joint towards the Toe, next to that on which they carry the Wax, there are a great many Rows of yellow, ſharp-pointed, ſtiff Briſtles, ſet all in order like the Teeth of Combs for Lint, which I look upon as the Inſtruments wherewith they break theſe Globulets, and prepare their Wax.

The Generation of a ſort of Bees in old Willows, by Sir Edm. King, n. 65. p. 2098.

XVII. 1. About the beginning of *May* 1670, Sir *J. Bernhard* ſent me a piece of old Willow-Wood out of *Northamptonſhire*, in which were lodged many Inſects curiouſly wrapt up in green Leaves, in ſeveral Channels or Burrows, each with 12, 14, or 16 Leaves round the Body, and ſeveral of them with as many little round bits of Leaves at each end, to ſtop them up cloſe. Theſe thus made up, are near an Inch long, or the beſt part of an Inch, put in one after another into a Bore made in the Wood, fit for their Reception. They are in the manner of Cartrages of Powder, wherewith Piſtols are wont to be charged. In ſome part of thoſe Burrows, they are placed ſo near one to another as to touch; in others, at ſome conſiderable diſtance. Theſe Inſects obſerve this Method in placing themſelves, that ſometimes they made a direct way into the length of the Wood, ſometimes they bore out into the Side, and run another way; thoſe Channels being not unlike the Burrows of Rabbets, all which they fill up with theſe round Appearances of wrapped Leaves, all regularly wrought. In which I find either ſomething alive, or Appearances of ſomething that had died there, and is putrified: In ſome, a great Number of Mites, of a dark Aſh-colour, ſhaped not unlike common Mites: In others, I find ſeeming Excrements of ſome ſmall Inſect, with the decayed Parts of the Dead Inſect; in others, white Maggots. Some of theſe Maggots I took out of their *Theca*, or Bag, and put them in warm Places in the Sun, and they thereupon grew ſomething bigger, but changed not Shape nor Colour, but died. The reſt I kept cloſe in a Box till the 8th of *July*. Then I took one of them out of the Wood, and opened the Leaves, and felt ſomething ſtir, hearing alſo an humming Noiſe like that of a Bee; and as ſoon as I had opened the *Theca*, a perfect Bee did fly out againſt my Window, as ſtrongly as a common Bee out of a Hive, having much of the colour and bigneſs of thoſe when they are New Flyers. The reſt being diſturbed, eat themſelves out. They have all Stings like Bees; and I am of Opinion, that they are common Bees.

By Mr. Fr. Willoughby *ib. p.* 2106. 2. I have had the good Luck to find a great many of theſe Cartrages in a rotten *Willow*; and by the Shape of the Maggot, was confident they would produce Inſects of the *Bee-Tribe*. Mr. *Snell*, an ingenious Gentleman, brought of them to the Wells at *Aſtrop*; and directing me to the Place where he got them, I there found great Plenty in the Trunk of a great *Willow*: Beginning to unfold ſome of them, Mr. *Wray* immediately judged them to be made up of Pieces of *Roſe*-Leaves; and called to mind, that this very Spring Mr. *Fr. Geſſop* brought him a Roſe-Leaf, out of which himſelf ſaw a Bee bite ſuch a piece, and fly away with it in her Mouth. Whereupon, ſearching the Roſe-Trees thereabouts, we found a great many Leaves with ſuch Pieces bitten out of them, as theſe Cartrages are made up of. The *Cuniculi*, or Holes, never croſs the Grain of the Wood, excepting where the Bee comes in, and where they open one into another. From the Place of Entrance, they are wrought both upwards and downwards; ſo that ſometimes the *Bee-Maggot* lies under her Food, and ſometimes above it. One End of the Cartrage, *viz.* That which is next the Entrance, is always a little Concave; the other End, which is fartheſt from the Entrance, a little Convex, and is received into the Concave of the next beyond it. The Sides of the Cartrage are made up of oblong Pieces of Leaves, and paſted together; the Ends, of round ones; and wherever they do not lie cloſe to one another, the intermediate Space is filled up with a Multitude of theſe little round Pieces, laid one upon another.

The Cartrages contain a Pap, or Batter, of the Conſiſtence of a Gelly, or ſomething thicker; of a middle Colour between Syrup of *Violets* and the Conſerve of *Red Roſes*; of an acid Taſte, and unpleaſant Smell. In each of theſe, at the Concave-End, there lies one *Bee-Maggot*, which feeds upon the forementioned Matter, till it grows to its full bigneſs, and then makes and encloſes herſelf in a *Theca* or Husk, of a dark-red Colour, or oval Figure; in which ſhe is changed into a Bee. The remainder of her Food you may find dried into Powder at the Convex End, and her Excrements at the Concave, without the *Theca*.

The Bees were of a ſhorter and thicker Shape, than the common Honey-Bee, more Hairy, *&c.* But the ſureſt Mark to diſtinguiſh them is, that the *Forcipes* or Teeth of theſe are bigger, broader, and ſtronger; in ſhape like thoſe of a *Waſp* or *Hornet*; from which ſhe alſo ſufficiently differs, in having a Tongue like a Bee, which they want.

They made their way out along the Channel through all the intermediate Cartrages, and not through the ſolid Wood. Of the Corruption of the Matter within the Caſes, when the *Bee-maggots* or *Nympha* happen to miſcarry, are bred, Firſt, little *Hexapods*, which produce Beetles; Secondly, *Maggots*, which produce Flies; Thirdly, *Mites*, *&c.*

From what hath been obſerved concerning this Bee, and by a great many more parallel Inſtances, it appears that it is the Bee-Maggot, and not the Old Bee, that covers the Cells before the Change: For here the Old Bee, when ſhe hath left Proviſion enough with an Egg, cloſes up the Cartrage, and hath no more to do, the Maggot a great while after making the *Theca*, which is Analogous to the Cover of the Cells.

By Dr. Liſter, n.160.p.594.

3. I have obſerved that the Bees breeding in Caſes of Leaves, are not very ſcrupulous in the choice of thoſe Leaves, but will make uſe of Exotic Plants; ſuch as *Blue Pipe* or *Syringe-Tree*. Here is a very ſtrange Oeconomy of Nature yet unſolved: The furthermoſt Bee, ſays Mr. *Willoughby*, makes her way out along the Channel through all the intermediate Cartrages: And according as theſe Channels run upwards or downwards in the Body of the Tree, the Maggot-Bee at the far or upper End of each Channel is firſt laid, and it ſhould ſeem both hatched and perfected firſt. But I take it otherwiſe, that that Bee which is neareſt Day, although it be laſt lain, is yet the firſt hatched; and I ground my Conjecture upon this, that it is probable that the Eggs in the Mother are all fit for laying, or all equally ripe and forward, as we ſay, at the time that the firſt of them was laid; but are not therefore all laid by the Dam, until ſhe has provided them of Meat and a Houſe, each ſeparately, as is the Nature of Bees; and yet in Recompence, the Warmth of her Body, or rather the daily increaſing Heat of the Summer-Seaſon, to which the Mother-Bee is continually expoſed (whilſt the firſt laid Eggs are ſheltered in their deep Channels) haſtens their Vitality ſo much, that they are hatched Worms, and begin to feed, before the firſt laid, and conſequently are firſt perfected into Bees: But this is Conjecture only, and not Obſervation.

By Mr. Fr. Willoughby. n.74.p.2221.

4. The Cartrages that I got at *Aſtrop*, in *Auguſt* 1670, do now in *July* 1671, almoſt every Day afford me a Bee; and I can hear them gnawing out their Way before I ſee them. So that there is nothing irregular in the Way of breeding of theſe Bees: But the Contrivance of God and Nature in it is very admirable. Having ſhut their young Ones in thoſe Cells with ſufficient Proviſion, they all, as well the uppermoſt as lowermoſt, before Winter, come to full growth, or are turned into *Nympha*'s; in which Condition they are deſigned to lie all Winter, as the moſt of *Inſects* do. The next Summer, thoſe muſt neceſſarily be firſt excited out of their *Torpor*, and changed into Flyers, by the external Heat and Air that lie next it. If any be laid ſo late, that they have not time enough to come to the State of *Nympha*'s before Winter, they will moſt certainly die; and then it is no Loſs nor Inconvenience, tho' their Cells be perforated.

A ſtrange ſort of Bees in the Weſt-Indies *by Mr.* Villermont, *n.* 172. *p.* 1030. *Fig.* 186

XVIII. M. *Villermont* has received from *America* a ſort of Honey-comb (of a different Make from the *European*) which is compoſed of ſmall Bottles or Bladders of Wax, of a browniſh Colour, inclining to Black; being as big as *Olives*, and ſhaped like the *Spaniſh Olives*. They hang together in Cluſters, almoſt like a Bunch of Grapes; and are ſo contrived, that each of them has an Aperture during the time of Work; but it is cloſed up as ſoon as the Veſſel of Wax is filled with Honey; and then the Bees go to work with another Veſſel.

Their Lodgings are ordinarily taken up in a hollow Tree, or the Cavity of a Rock, by the Sea-ſide; theſe being the propereſt Places to ſecure them from ſuch Animals as are greedy of their Honey, and therefore likely to moleſt them: And they have the more need of this Caution, becauſe they are more liable to be diſturbed than ordinary Bees, as having no Stings, and being capable of doing good, but no hurt to any thing, as the Party, that lived at *Cayenne* very well knows. When the Combs are removed, they muſt be carried gently, and in the ſame Poſition they lay in, till you come to the Place where you deſign to take out the Honey.

The Honey itſelf is clear and liquid as Rock-Water, and hardly to be diſtinguiſhed from it by the Sight. When you would take it out, you muſt pierce every Bottle a little more than $\frac{1}{3}$ from the bottom; for if you pierce it lower, you find a Bottom or Sediment, whoſe thickneſs would hinder it from running; and as you prick every Bottle, you muſt have ſome Veſſel ready to receive what comes from it. This Gentleman ſays, that he thinks, the Liquor is one of the moſt agreeable Things in the World. If you drink Faſting the Quantity of a good Glaſs, or about half a Pint, it will give you 2 or 3 Stools in about two hours time, according to the Temperament of the Party; but if you drink it at Meals, it does not purge at all.

An Early Swarm of Bees; by Mr. Rich. Reed, *n.* 70. *p.* 2128

XIX. On *Thurſday*, *March* 9, $167\frac{0}{1}$, there was at the next Houſe to mine (in *Herefordſhire*) a Swarm of Bees. It was a very fair Day to entice them; but elſe we never have them till the Middle of *May*. I had it from the Owner, one *Parry*, now in my Work. And I enquired of him, whether they did not leave the Hive (as ſometimes they do unſeaſonably) either for want of Food, or out of Diſtaſte? He told me no; but there are as many left behind as came forth. But I (who have ſometimes ſtudied the Regimen of that little induſtrious wiſe Creature) do conceive, that Poverty drew them abroad to ſeek their Fortunes; the infinite Wiſdom having imparted ſuch a Providence to that little Commonwealth, as to ſend part of their Company abroad to ſhift, before their whole Stock of Food ſhould be conſumed, to the Deſtruction of them all.

A Bee-Houſe uſed in Scotland; *by Mr.* H. Oldenburg, *n.* 96. *p.* 6076.

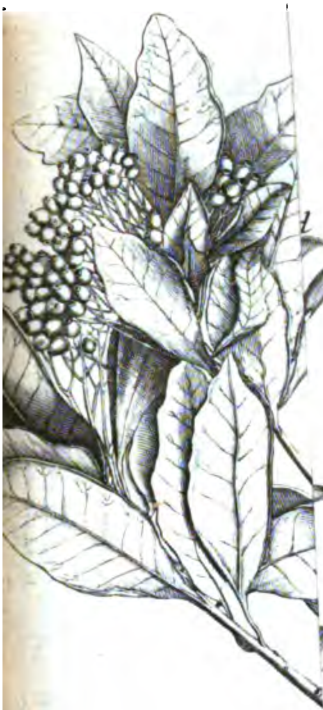
XX. A, The *Bee-Houſe*, lying on one Side, with the Frame placed in it.

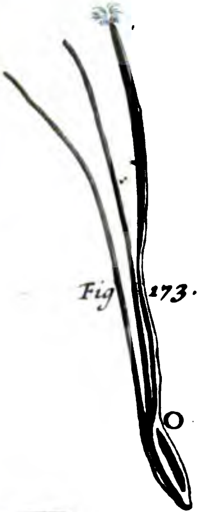
B B B B B B B B, The Frame.

C C C C, The Screw-Pins that hold the Frame faſt.

D, The Square Hole at top open.

E.

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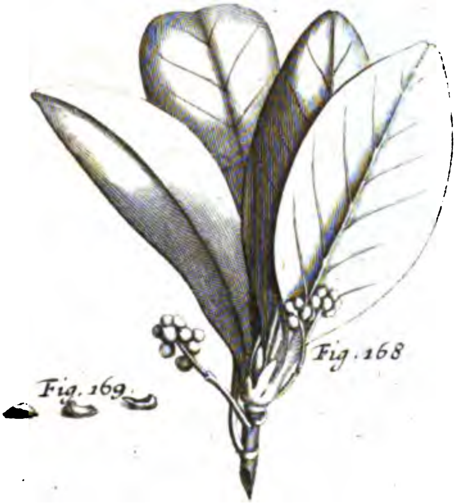
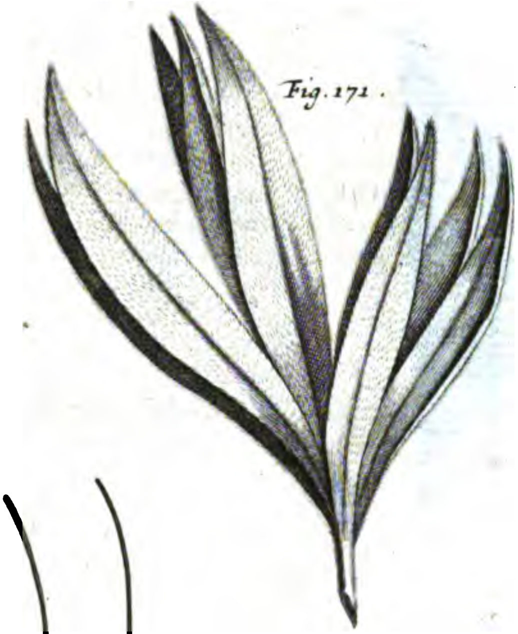


Fig. 168

Fig. 169.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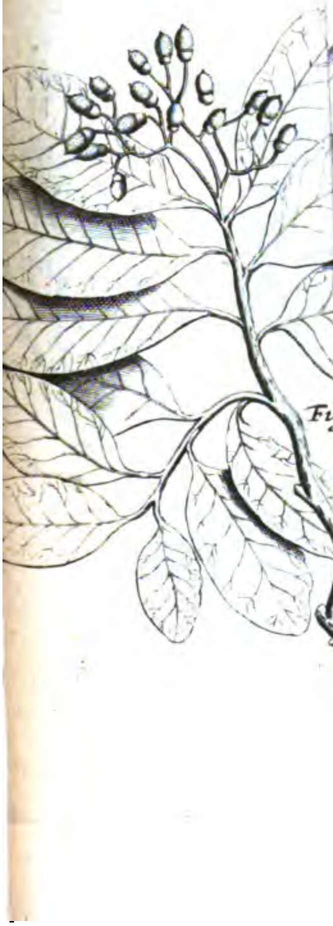


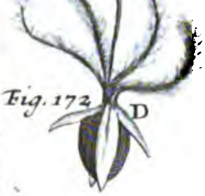
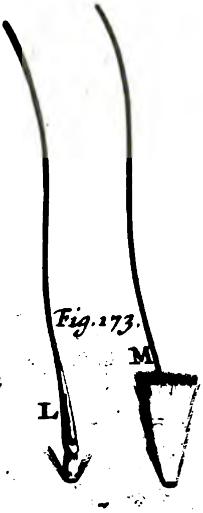


Fig. 172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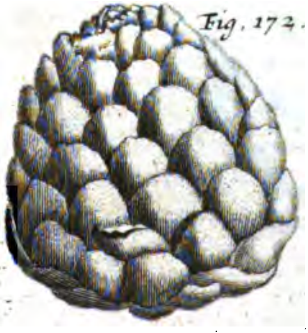
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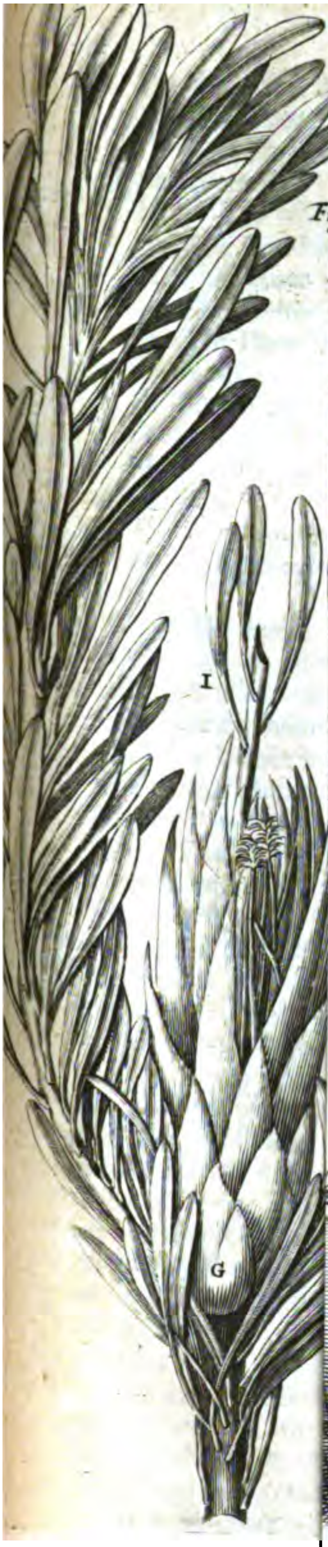
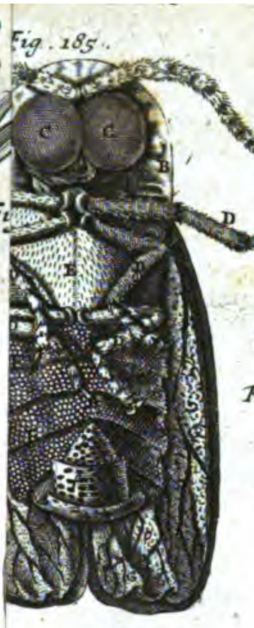
Fig 172

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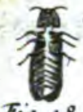
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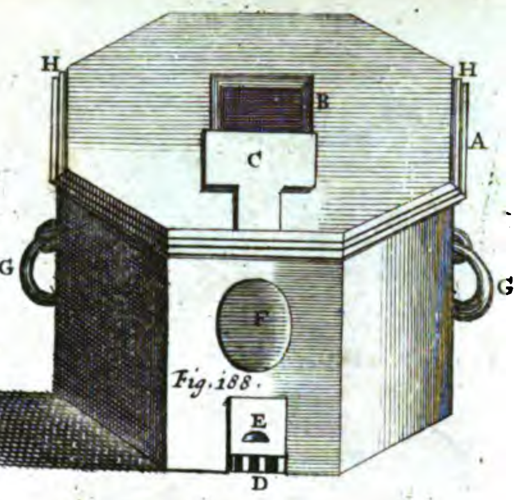
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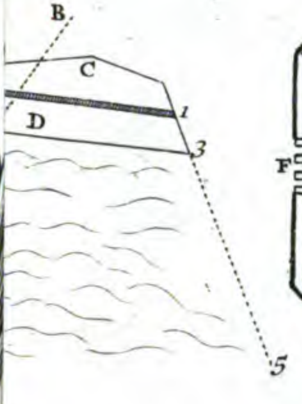

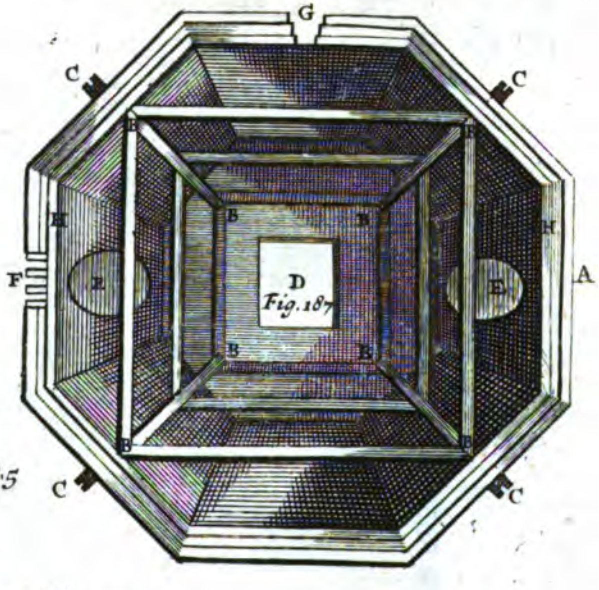
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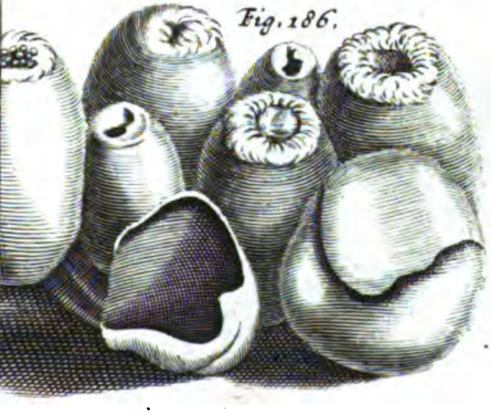
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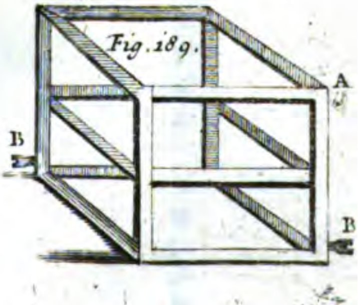
Fig. 189.

E. The Windows.
F. The Door, for the Bees to go in and out. *Fig*.187.
G. The Place by which the Knife enters to cut the Honey-Comb aſunder upon occaſion.
HH. The inward Creaſe at the bottom.

A. The Bee-Houſe ſet upright.
B. The ſquare Hole, through which the Bees work downward. *Fig*.188.
C. The Shutter that covers the Hole upon occaſion.
D. The Door for the Bees.
E. A Sliding Shutter that covers the Door in Winter.
F. The Window.
GG. The Handles for lifting all.
HH. The outward Creaſe at the top, for faſtening one Bee-houſe over another.

A. The Frame for the Bees to faſten their Work upon.
BB. The Screw-Nails. *Fig*.189.

This Bee-houſe (which was ſent by Sir *Will. Thompſon*) is made of Wainſcot, about 16 Inches in height, and 23 in breadth, between the oppoſite ſides. It hath 8 ſides, each almoſt 9 Inches in Breadth. It is cloſe covered at top with Boards, having a ſquare Hole in the middle, five Inches long, and about four Inches broad, with a *Shutter* that ſlides to and fro in a Groove about half an Inch longer than the Hole. It hath two Windows, oppoſite to one another; and may have more of any Figure, with Panes of Glaſs and Shutters. The Door for the Bees is divided into three or four Holes about half an Inch wide, and as high, with a Shutter that ſlides in a Groove to cover them in Winter. It hath 2 Iron Handles with Joints, to be placed about the middle, if there be no Windows on the ſides where they are; or above them, if there be. At the top it hath a Creaſe all round it, half an Inch in depth on the outſide, and one Inch and half high; and another on the inſide at bottom, which ſerves to fix them when ſet upon one another. It hath alſo a Hole about two Inches in height, and as much in breadth on one ſide at bottom, by which the Knife is put in to cut the Bees Work, that paſſes through the Hole from one Bee-houſe into another, as they work downward into the empty Houſe, which hath a ſliding Shutter to cover it. Within the Bee-Houſe there is a ſquare Frame, made of Four Poſts joined at top, at bottom, and in the middle, with Four Sticks for the Bees to faſten their Work upon: Which, tho' they may ſerve, yet it may be ſecurer to have Two more added in every of their Places, croſſing the Frame either from the middle of the oppoſite Side-Sticks, or from the Angles where the Poſts are placed.

This manner of Bee-Houſe is uſeful for preventing the Swarming of Bees: For when the Bee-Houſe wants room for the young Bees, 'tis known that they ſwarm and fly away to find a Houſe for themſelves: Which is prevented, by placing an empty one made thus, under the full one, having the Door at the top open, that they may work downwards into it. And when both are full, the Bees will be all in the loweſt Houſe; and then to get the Honey and Wax, without deſtroying or troubling the Bees, with a thin long Knife, broad at the end, and ſharp on both ſides; the Bees-work is to be cut as low as can be, and the uppermoſt Bee-houſe to be lifted off by the Handles; and being reverſed, the Screws are to be taken out, and then the Frame, with all the Bees-work upon it, will eaſily ſlip out; and ſo the empty Bee-houſe may be forthwith ſet under the other, if need be, and the uppermoſt having the ſquare Hole above covered with the *Shutter*, ſome other Cover may be ſet over it, to keep the Bees from the Injuries of the *Weather*. And if this Separation be made in the Spring, or Summer, the Bees will love their new Houſe the better, that it hath been uſed before.

Swarms of Locuſts *in* Wales, *by Mr.* Edw. Floyd, *n.* 208. *p.* 45.

XXI. I am informed that great Swarms of Locuſts have lately appeared in *Wales*. They were firſt ſeen about the 20th of *October*, 1693, ſcattered about the Fields in *Marthery*-Pariſh in *Pembrokeſhire*; where they were generally taken notice of at firſt, becauſe of the unſeaſonableneſs of the Time for *Graſhoppers*; but afterwards, for that upon further Examination, they found them diſtinct from our *Engliſh Graſhoppers*, in bigneſs, colour, &c. I could not learn, that any of them have been ſeen flying in that Country: But from *North Wales* I am informed, that two vaſt Swarms of them had been ſeen in the Air not far from *Dol-gelheu*, a Market-Town of *Merionydh-ſhire*, and I gueſs, by the Date of my Friend's Letter, that it was near the ſame time that thoſe others of *Pembrokeſhire* had been taken notice of in the Fields.

They are of the ſame Species with ſome *African Locuſts* in my Cuſtody in the *Muſæum Aſhmol.* for which we are obliged to Mr. *J. Aubrey*, who received them ſome Years ſince from *Tangier*. This *Pilgrim-Locuſt* I call *Locuſta Erratica, Alis Ichthyocollæ adinſtar Pellucidis, Reticulatis Maculis conſperſis.* It is in length (from the Head to the tips of the Wings) three Inches and a quarter, of a reddiſh Colour all over, except the Wings. As to the *Head* and *Caputium*, it reſembles the fourth *Fig.* of *Moufett*. The Eyes are Prominent and very large, ſomewhat of the form and bigneſs of *Gromwel-Seeds*, of a reddiſh Colour, elegantly ſtreaked.

The *Autennæ* are about the bigneſs of a *Hog*'s *Briſtle*, and curiouſly *Geniculated*. The firſt pair of Legs are not quite an Inch long; the Second ſomewhat above that length; but the Third two Inches and a quarter. Theſe Hind Legs are very beautiful, for the Thighs are Hexangular, and elegantly ſealed on the outſide, with a black Liſt extended length-ways through the midſt of them. The Shanks are of a lively red colour, adorned on the hinder part with two orders of ſmall ſharp Prickles, placed not oppoſite to each other, but alternately. The Wings are about three Inches long, reſembling very much thoſe of the larger *Libellæ*, or *Dragon-flies*, but all over garniſhed (the outer Wings at leaſt) with reticulated black Spots.

Plin. *Lib.* xi. *c.* 19. *Jul. Obſequens in Lib. Prodigiorum*, Moufett.

I ſee not much Reaſon to doubt but that theſe are the very ſame Species of *Locuſts*, ſo famous in Hiſtory for their wandring over, and depopulating whole Regions.

XXII.

Green Worms *in* Wales; *by* *M.* Edw. Floyd, *n.* 108. *p.* 45.

XXII. I find in a *MS.* Hiſtory of *Pembrokeſhire* (written about the Year 1603, by one Mr. *Geo. Owen*, a Gentleman of that Country, who ſeems to have been a Perſon of conſiderable Accuracy and Veracity) that about the beginning of *June*, 1601, a piece of Ground to the quantity of 200 *Engliſh Acres*, was covered ſuddenly (as if the ſame had fallen in a Shower out of the Air) with a kind of Caterpillars or Green Worms, having many Legs, and bare, without Hair. They were found in ſuch abundance, that a Man treading on the Ground ſhould tread upon 20 or 30 of them: And in this ſort they continued for the ſpace of three Weeks or more, no Man knowing how they came, nor any of the like ſort were ever ſeen in the Country before nor ſince; and being opened, there was nothing found within them but Graſs. The Place was on a Hill in the Pariſh of *Mean-Clochog* above *Hynnon Dhewi* or *Phynnon Dhewi*. They were found as it were with one accord to go one way, *viz.* up the Hill, and went over the Hill a quarter of a Mile and more: And as they went, they devoured and conſumed the Graſs, that the Ground appeared bare and white like Tallow. And after they had continued there three Weeks, there reſorted thither an infinite Number of *Sea-Maws* and Crows, as if all of many Countries had been ſummoned thither, who in a few Days conſumed them all. Alſo Swine fed upon theſe *Worms* eagerly, and waxed very fat.

Swarms of Beetles *in* Ireland; *by* *Dr.* Tho. Molyneux, *n.* 234. *p.* 741.

XXIII. According to the beſt Account I can get of the vaſt Swarms of Inſects which of late Years have much infeſted this Kingdom of *Ireland*, I find that this Flying Army was firſt taken Notice of in the Year 1688. They appeared on the South-Weſt Coaſt of the County of *Gallway*, brought thither by a South-Weſt Wind, one of the common, I might almoſt ſay Trade-winds, of this Country. From hence they made their way into the more Inland Parts, towards *Hedford*, a Place belonging to Sir *George St. George*, Bart. about 12 Miles North from the Town of *Gallway*. Here, and in the adjacent Country, Multitudes of them ſhewed themſelves among the Trees and Hedges in the Day-time, hanging by the Boughs Thouſands together in Cluſters, ſticking to the Back one of another, as is the manner of Bees when they ſwarm. In this poſture, or lying ſtill and cover'd under the *Leaves* of the Trees, or clinging to the Branches, they continued quiet with little or no Motion during the heat of the Sun: But towards Evening or Sun-ſet, they would all ariſe, diſperſe, and fly about, with a ſtrange humming Noiſe, much like the beating of Drums at ſome diſtance; and in ſuch vaſt incredible Numbers, that they darkned the Air for the ſpace of two or three Miles ſquare.

Thoſe that were travelling on the Roads, or abroad in the Fields, found it very uneaſy to make their way through them, they would ſo beat and knock themſelves againſt their Faces in their Flight, and with ſuch a Force, as to ſmart the place where they hit, and leave a ſlight Mark behind them.

A ſhort while after their coming, they had ſo entirely eat up and deſtroy'd all the Leaves of the Trees for ſome Miles round about, that the whole Country, though it was in the middle of Summer, was left as bare and naked as if it had been in the depth of Winter: and the grinding of the Leaves in the Mouths of this vaſt Multitude altogether, made a ſound very much reſembling the ſawing of Timber.

They came alſo into the Gardens, and deſtroy'd the Buds, Bloſſoms, and Leaves of all the Fruit-Trees, that they were left perfectly naked, nay, many of them that were more delicate and tenderer than the reſt, loſt their Sap as well as Leaves, and quite withered away, ſo as they never recovered it again; particularly ſeveral Trees in the curious Plantation of one Mr. *Martin.*

Nay, their Multitudes ſpread ſo exceedingly, that they got into the Houſes, where Numbers of them crawling about, were very irkſome; and they would often drop on the Meat as it was dreſſing in the Kitchin; and frequently fall from the Cieling of the Rooms into the Diſhes as they ſtood on the Table while they eat; ſo extremely offenſive and loathſome were they.

Their numerous creeping Spawn, which they had lodged under Ground, next the upper Sod of the Earth, did yet more harm in that cloſe Retirement, than all the Flying Swarms of their Parents had done abroad; for this young deſtructive Brood lying under Ground, fell a devouring the Roots of the Corn and Graſs, and eating them up, ruined both the Support of Man and Beaſt. This Spawn, when firſt it gave ſign of Life, appeared like a large Maggot, and by taking Food, and increaſing every Day, became a bigger Worm, till at length it grew as big as a great *white Caterpillar*; from whence according to the uſual Transformation natuaal to theſe ſmaller Animals, came forth this our Flying Inſect.

The Rage of this Plague of Vermin was fortunately check'd ſeveral ways; high Winds, wet and miſling Weather deſtroyed many Millions of them in one Day's time: Whence I gather, that though we have them in theſe *Northern* moiſt Climates, they are more natural, and more peculiarly belonging to warm and dry Countries. Whenever theſe ill Conſtitutions of the Air prevailed, their Bodies were ſo enfeebled, they would let go their holds, and drop to the Ground from the Branches where they ſtuck, and ſo little a Fall as this, at that time, was of ſufficient force quite to diſable, and ſometimes perfectly kill them. Nay, it was obſervable, that even when they were moſt Agile and Vigorous, a ſlight Blow or Offence would for ſome time hinder them of Motion, if not deprive them of Life.

During theſe unfavourable Seaſons of Weather, the Swine and Poultry of the Country watched under the Trees for their falling, and eat them up in abundance, being much pleaſed with the Food, and thriving well upon the Diet. Nay, I have been aſſured, that the poorer ſort of the *Native Iriſh* (the Country then labouring under a Scarcity of Proviſion) had a way of dreſſing them, and lived upon them as Food.

In a little time it was found that Smoak was very offenſive to theſe Flies; and by burning *Heath*, *Fern*, and ſuch like Weeds, in this or that Corner of their Gardens or Orchards, which lay moſt convenient for the Wind to diſperſe it among the Trees, they would ſecure their Gardens, and prevent their Incurſions; or if they had entered, drive them out again.

But towards the latter end of the Summer, they conſtantly retired of themſelves; and ſo wholly diſappeared, that in a few Days you ſhould not ſee one of them left. Some think, that they take their Flight like Swallows, and other Birds of Paſſage, as they are called, to a more diſtant Country and warmer Climate. But the true Reaſon of their diſappearing, I take to be, that after their Coition is over (for 'tis about this time they are ſeen to couple by faſtening to one another by their Tails) they retire under Ground, in order to lay their Spawn there, for a ſucceeding Generation; and likewiſe to compoſe and ſettle themſelves to ſleep for the reſt of the enſuing Year, as ſeveral other Animals are known to do; for Inſtance, *Snails* among Inſects, the *Hedge-Hog* among the Beaſts; and I have good Reaſon to think, the *Ortygometra*, or *Rail*, among the Birds. And what confirms me in this Opinion concerning theſe Inſects, is, that I am certainly informed by ſeveral good Hands, that in the Spring-time, by accidental Digging and Ploughing up the Ground, great Hollows or Neſts of them are frequently diſcovered and broken up, where they find whole Buſhels together in one heap, but in ſuch a quiet Condition, they ſeem to have but little Life and Motion; for they do not ſtir, unleſs you touch or diſturb them, and then move but little and feebly, as if they had been aſleep, and were awaken'd out of it. Theſe large Caverns, to which they retire, are often met with under a firm, ſolid, Surface of Earth, that has not been ſtirred or ploughed in many Years before; and no manifeſt Paſſage can be diſcovered how they got there.

In the Summer (1695 or 96) all along the South-Weſt Coaſt of the County of *Gallway*, for ſome Miles together, there were found dead on the Shoar ſuch infinite Multitudes of this Vermin, and in ſuch vaſt Heaps, that by a moderate Eſtimate, one computed there could not be leſs than forty or fifty Horſe-Loads in all. Theſe, as I take it, were a new Colony, or ſupernumerary Swarm, from the ſame place whence the firſt Stock came to us, in 1688, driven by the Wind to Sea from their Native Land, which I conclude to be *Normandy* or *Brittany* in *France*, it being a Country much infeſted with this Inſect, and that lies very open and expoſed to all theſe Parts of *Ireland*, and from whence *England* heretofore has been peſter'd in the ſame manner with Swarms of this Vermin. But theſe meeting, by good Fortune, with a contrary Wind before they could reach Land, their Progreſs was ſtopt, and tired with their Voyage, they were all driven into the Sea, which by the Motion of its Waves and Tides caſt their floating Bodies in heaps upon the Shore. And this was a moſt lucky Accident; for had this ſecond Supply arrived, they would have exceedingly increaſed the Numbers of thoſe which are already very troubleſome to us.

Moufett de Inſect. p. 160.

It is obſerved, that they ſeldom keep above a Year together in a Place; and they compute their uſual Stages, or March, to be about ſix Miles in a Year. Hitherto they have directed their Progreſs Weſterly; following the Courſe of that Wind which blows moſt commonly in that Country.

And this laſt Year, 1696, they reached as far as the *Shannon*, and ſome of the ſcattered looſe Parties croſt the River, and got into the Province of *Leinſter*; but they were met there by a ſtronger Army of *Jack-Daws*, which devour'd great Numbers of them. They begin to be apprehenſive of them in the Queen's County, but they hope to divert their Paſſage thither by firing the Heath upon the Mountains between them and the King's County.

Wherever the Country has been infeſted with this Vermin, with one Conſent, though erroneouſly, they have given them the Names of *Locuſts*. But the true *Locuſt*, much reſembling in Shape a common Graſhopper, tho' larger, is quite a different ſort of Inſect from this, which belongs to that Tribe, call'd by the Naturaliſts, Κολεόπτερος, *Vagini pennis*, the *Scarabeus* or *Beetle-kind*, that has ſtrong thick Caſes to defend and cover their tender thin Wings, that lie out of ſight, and next the Body. And this Species is certainly that particular Beetle, called by *Ariſtotle* in his *Hiſtory of Animals*, Μελολάνθυς, from its devouring the Bloſſoms of *Apple-trees*; and is the *Scarabeus Arboreus* of *Moufett* and *Charleton*; called by the *Engliſh*, *Dorrs* or *Hedge-Chafers*. They are much of the bigneſs of the common black Beetle, but of a browniſh Colour, ſomething like that of Cinnamon; they are thickly beſperſed with a fine, ſhort, downy Hair, that ſhews as if they were powder'd all over with a fine ſort of Duſt; the Caſes of their Wings do not entirely cover all the Back; for their long picked Tails, where lie the Organs for Generation, reach a good way beyond them; and the Indentures or Joints of each ſide of their Belly, appear much whiter than the reſt. They are exactly figured by Dr. *Liſter*, *Scarab. Tab. Mut.*

Hiſt. Anim.
Aldrovand.
de Inſect.
l. 4.

I am fully convinced that this Inſect is the ſelf-ſame to which the *Septuagint*, and the *Vulgar Latin* Tranſlation retaining the *Greek* Word, give the Name Βροῦχος, or *Bruchus*, derived from Βρύχω *Freno vel Strideo*, intimating the remarkable Noiſe it makes both in its eating and flying. It is often mentioned in Holy Scripture, *Levit.* xi. 12. *Joel* i. 4. and ii. 25. *Nahum* iii. 16, 17. But I find our *Engliſh Verſion* almoſt conſtantly tranſlates this Word Βροῦχος, though improperly, as I think, *Cancer-Worm*; ſince this denotes only a Reptile, or creeping Vermin, whereas that Word imports certainly a flying Inſect; for the Βροῦχος, *Nahum* iii. 16, 17. is expreſly ſaid to fly, and have Wings; and its Nature and Properties are moſt truly and particularly deſcribed in theſe Words, *It ſpoileth and flieth away, they camp in Hedges in the Day, and when the Sun ariſeth they flee away, and their Place is not known where they are:* That is, they then retire again to the Hedges and Trees, where they lie quiet and concealed till the Sun ſets again.

I find, indeed, the Word Βροῦχος, better tranſlated *Locuſt* or *Beetle*, in that odd Clauſe of the *Jewiſh* Law, *Lev.* xi. 22. where *Moſes* permits the *Iſraelites* to eat the *Locuſt* after his kind, and the *Bald-Locuſt* after his kind, and the *Beetle* after his kind, and the *Graſhopper* after his kind. I muſt confeſs, it long ſeemed to me very unaccountable, that here among the pure wholeſome Creatures, proper for human Nouriſhment, *Beetles*, and thoſe other naſty, dry, and unpromiſing Vermin, ſhould be thought fit to be reckoned up as clean and proper for the Food of a Man: But ſince I have had ſome little Experience of what has happened among ourſelves, I cannot but admire the ſagacious Prudence of that Divine Lawgiver. 'Tis certain, *Paleſtine*, *Arabia*, *Ægypt*, and the other Neighbouring Countries about them, were all extremely ſubject to be infeſted with theſe ſorts of pernicious *Vermin*, and therefore *Moſes* foreſeeing the great Dearth and Scarcity that they might one Day bring upon his People, gives them here a permiſſive Precept, or a ſort of Hint what they ſhould do, when the Corn, Graſs, Olive-Trees, Fruit-Trees, Vines and other Proviſions were deſtroyed by the *Locuſt* and Βρȣ̃χο, or *Beetles*, ſwarming in the Land; why then, for want of other Nouriſhment, and rather than ſtarve, he tells them, they might eat and live upon the filthy Deſtroyers themſelves, and yet be clean. And thus we ſee the native *Iriſh* were Authors of a practical Commentary on this Part of the *Levitical* Law, and by Matter of Fact have explained what was the true Senſe and Meaning of this otherwiſe ſo dark and abſtruſe a Text. It is alſo more than probable that this ſame deſtructive Beetle we are ſpeaking of, was that very kind of *Scarabeus*, the idolatrous *Ægyptians* of old had in ſuch high Veneration, as to pay divine Worſhip to it, and ſo frequently grave its Image upon their *Agulios* and *Obeliſks*, as we ſee at this Day. For nothing can be ſuppoſed more natural, than to imagine a Nation addicted to Polytheiſm, as the *Ægyptians* were, in a Country frequently ſuffering great Miſchief and Scarcity from Swarms of devouring Inſects, ſhould from a ſtrong Senſe and Fear of Evil to come (the common Principle of Superſtition and Idolatry) give ſacred Worſhip to the viſible Authors of theſe their Sufferings, in hopes to render them more propitious for the future. Thus 'tis allowed of all Hands, that the ſame People adored as Gods the ravenous Crocodiles of their River *Nile*; and thus the *Romans*, though more polite and civilized in their Idolatry, *Febrem ad minus nocendam venerabantur, eamque variis* Templis exſtructis *colebant*; *ſays* Valerius Maximus, L. 2. c. 5.

XXIV. I was amazed to ſee that the Genitals of the Beetle, as to the Veſſels of the Teſticles, agree exactly with thoſe of the human Teſticle, and conſiſt of only one very ſlender, long, hollow Rope, prodigiouſly tortuous, and (which I have not yet ſeen in Men) with a blind Beginning or Apex.

The Vaſa teſticularia *of a* Beetle; *by Dr.* Swammerdam, *n.* 94. *p.* 6041, 6042.

I have therefore thought it proper to tranſmit a Figure of them to you, in which are chiefly repreſented not only the Teſticles compoſed of one Rope, two Feet and ſix Inches long, but likewiſe the Vaſa Deferentia, ſpewing out Plenty of white Semen, when they are pricked; likewiſe ſix very beautiful Veſicles, or rather Seminal Glands; as alſo the Ducts of the Seminal Glands ſtretched, containing a yellowiſh Seminal Liquor, in the ſame Manner as is obſerved both in Men and Brutes.

XXV. I here ſend you the Figure of a large *flying Beetle*, of a dark ſhining brown, with a huge pair of Horns, in proportion to the Body, ſhaped and branched exactly like a *Stag*'s or *Hart*'s, from which laſt it hath its Denomination; our People in *Virginia* and *New-England* calling it a Flying Hart. It flies high and ſwift, and reſts moſt commonly upon Branches

A flying Hart; *by* - - *n.* 127. *p.* 652.

or Trunks of ſtanding Trees, where, as ſoon as it has taken up its Station, it begins with a ſhrill chirping Voice, which it raiſes by little and little, till it makes the whole Woods ring again, and then leſſens gradually, till it ceaſeth with a kind of ſilent Murmur, as if the little Creature had rung itſelf aſleep; then it flies to ſome other Place, and begins the ſame Tune again.

The Horns are of a ſhining hard Subſtance, and the Tips of them touch the ſame Plane with the Belly.

A Muſk-ſcented Inſect, feeding upon Henbane, *by* Dr. M. Liſter, *n.* 72. *p.* 2176.

XXVI. There is a *Cimex* of the largeſt Size, of a red Colour, ſpotted black, and which is to be found very frequently and plentifully, at leaſt in its Seaſon, upon *Henbane:* I therefore in my private Notes, intitle it *Cimex Ruber, Maculis nigris diſtinctis, ſuper Folia Hyoſcyami frequens.* This Inſect in all probability doth feed upon this Plant (on which only we have yet obſerved it) if not upon the Leaves, by ſtriking its Trunk (the Note of Diſtinction of this Kind of Inſect from the reſt of the *Beetle-kinds)* into them, and ſucking thence much of its Subſtance, like as other ſorts of *Cimices* will upon the Body of Man, *&c.* yet upon the unctuous and greaſy Matter, with which the Leaves ſeem, to the Touch, to abound. It is farther obſervable, that that horrid and ſtrong Smell, with which the Leaves of this Plant do affect our Noſtrils, is very much qualified in this Inſect, and in ſome Meaſure aromatick and agreeable; and therefore we may expect, that that dreadful *Narcoſis,* ſo eminent in this Plant, may likewiſe be uſefully tempered in this Inſect.

About the latter end of *May,* and ſooner, you may find adhering to the upper Side of the Leaves of this Plant, certain Oblong, Orange-coloured Eggs, which are the Eggs of this Inſect. Theſe Eggs yet in the Belly of the Females, are white, and are ſo ſometimes after they are laid: But as the Young ones grow near the Time of their being hatched, they acquire a deeper Colour, and are hatched *Cimices,* and not in the Diſguiſe of Worms. If the riper Eggs be cruſhed upon white *Paper,* they ſtain it of themſelves, without any addition of Salt, with as lively a *Vermilion,* or *Coleur de Feu,* as any thing I know in Nature; *Cochineal* ſcarce excepted, when aſſiſted with Oil of Vitriol.

Other Muſk-ſcented Inſects; by Mr J Ray, *n.*74 *p.*2220.

XXVII. 1. I have ſeen two ſorts of Inſects which ſmell of Muſk. The one is like the common *Capricornus,* or *Goat-Chafer,* which is mentioned by all Naturaliſts that write of Inſects, and which ſmells ſo ſtrong of that Perfume, that you may ſcent it at a good Diſtance, as it flies by, or ſits near you. The other is a ſmall ſort of Bee, which in the South and Eaſt Parts of *England,* is frequently to be met withal in Gardens among Flowers in the Spring-time.

By Dr. M. Liſter, *n.* 76. *p.* 2280.

2. The two Inſects mentioned by Mr. *Ray,* ſmell of Muſk to an high Degree. The ſmall Bees are very frequent in the *Woods* in *Lincolnſhire,* and about the latter en[illegible] to be found in Paſtures and Meadows upon [illegible] of *Ranunculus*; but it is ſomething improper

proper to ſay, Bees feed on Flowers: And likewiſe the ſame Bees are no leſs frequent on the Flowers of *Dens Leonis*, *&c.*

The *Sweet Beetle* is a very large Inſect, and well known about *Cambridge.* All the Trials I have made to preſerve them with their Smell, have proved ineffectual: For both Sorts of theſe Inſects will of themſelves, in a very few Weeks, become almoſt ſcentleſs.

To theſe, I ſhall add another ſweet-ſmelling Inſect, which is a Hexapode Worm, feeding on *Gallium Luteum.*

Mr. *Willoughby* informs me, that he hath found the *Goat-Chafer*, or *ſweet Beetle*, out of Seaſon as to that Smell. Perhaps it might be at the time of the *Coit:* Foraſmuch as at that time, when I took them highly perfumed, I had obſerved the Female full of Eggs. n. 77. p. 3003.

XXVIII. 1. It is generally believed, that the *Cochineel* comes out of a Fruit called the *Prickle-Pear*, bearing a Leaf of a ſlimy Nature, and a Fruit blood-red, and full of Seeds, which give a *Dye* almoſt like to *Braſiletto-Wood*, that will periſh in a few Days by the Fire; but the Inſect ingendred of this Fruit or Leaves, gives a permanent Tincture, as is generally known.

The Cochineel-Fly; *by* —— *n.* 40. *p.* 796.

There grows a Berry (by report) both in *Bermudas* and *New-England*, called the *Summer-Iſland Reed-Weed*; which Berry is as red as the *Prickle-Pear*, giving much the like Tincture; out of which Berry come out firſt Worms, which afterwards turn into Flies, ſomewhat bigger than the *Cochineel-Fly*, feeding on the ſame Berry; in which we read there hath been found a Colour, no whit inferior to that of the *Cochineel-Fly*; and as to Medicinal Virtue, much exceeding it.

'Tis alſo probable that Inſects may be engendred out of other Vegetables; either Herbs, Berries, and other Fruit and Woods, giving the Tincture of its Original, which will hold in Grain.

To breed Inſects out of Herbs, dry them, for they yield the beſt Tincture, otherwiſe ſtamp them, and let them dry, till they will ſuffer no more Juice to run from them (do this in the Sun, or in a proportionable Heat:) or if dried, infuſe them with Water, in a Heat for 24 Hours, then vapour away the Water, till the Diſſolution be as thick as a Syrup (but for this uſe ſtrain them not from their *Fæces*) take this Maſs, and put it into an earthen or wooden Veſſel, covered with ſome Straw, or ſomething elſe of that Nature, that it lie not too cloſe, and ſo proportion the quantity to the *Veſſel*, that the Air may come about, and into the Maſs, yet not too much. Then ſet this Veſſel in a Ditch or Pit made in the Earth, in a ſhady Place, and put about it ſome wet Leaves, or ſome ſuch putrifying Rubbiſh, and over it a Board, and on that ſome Straw, or the like, and it will produce firſt a ſhelly, huſky Worm, and then a Fly of the Tincture of *Concrete*, but durable, and ſomewhat more advanced.

To generate other Flies, for like uſe.

And as for Berries, ſtamp and boil them, evaporating them to the Conſiſtence of a *Rob*, and then uſe them as the former.

Laſtly, for Woods, infuſe them in Water, being firſt pulveriz'd, and boil out their Tincture, and then evaporate the Water to ſuch a Thickneſs, as the other, and handle them in the like way.

The *Flies* will play about the ſide of the Veſſel, and the Surface of the Matter; which taken, are to be killed in a warm Pan or Stove, and ſo dried and kept.

By —— *n.* 191. *p.* 509.

2. An old *Spaniard* at *Jamaica*, who lived many Years in that Part of the *Weſt-Indies*, where great Quantities of *Cochineel* is made, affirms, that the Inſect, whereof it is made, is the very ſame which we call the *Lady-bird*, or *Cow-lady*. It appears, he ſays, at firſt like a ſmall Bliſter, or little Knob upon the Leaves of the Shrub on which they breed, which afterwards by the Heat of the Sun becomes a live Inſect, or ſmall Grub. Theſe Grubs in Proceſs of Time become Flies, and being come to full Maturity (which muſt be found out by Experience, in collecting them at ſeveral Seaſons) they kill, by making a great ſmother of ſome combuſtible Matter, to windward of the Shrubs whereon the Inſects are feeding (having before ſpread ſome Cloaths under the Plants) whereby all the Inſects being ſmother'd and kill'd by ſhaking the Plants, will tumble down upon the Cloaths; thus they are gathered in great Quantities with little Trouble. Then they ſpread them on the ſame Cloaths in ſome bare ſandy Place, or ſtone Pavement, and expoſe them unto the Heat of the Sun until they are dry, and their Bodies ſhrivelled up, which being rubbed gently betwixt ones Hands, will crumble into Grains, and the Wings ſeparate from them, which muſt be garbled out. Others, 'tis ſaid, do expoſe them to the Sun in broad and ſhallow copper Baſons, wherein the Reflection of the Sun will dry them ſooner.

The Tree or Shrub on which they breed, call'd the *Prickle-Pear*, or *Indian Fig*, is eaſily and quickly propagated, by putting a ſingle Leaf above half its depth into the Ground, which ſeldom fails to take Root, and throw out other new Leaves at the Top thereof. Others ſay, they may be raiſed from the Seed or ſmall Grains, which are to be found in the proper Seaſon in the Fruit, which is ſomething like a *Fig*, ariſing out of certain yellow Flowers, or Bloſſoms, that grow out at the Tops of the uppermoſt Leaves; which Fruit is full of a red Pulp, that, when full ripe, ſtains the Hands of them that touch it, like *Mulberries*, with a purple or ſanguine Colour, whereon, or on the Bloſſoms, ſome ſay the Inſects do feed; which haply may be the Occaſion of that rich Tincture within their Bowels.

Figures of the Cochineel-Fly, *by Dr.* Tyſon, *n.* 176. *p.* 1202.

3. The Figures 191, 192, 193, repreſent the *Cochineel-Fly* as ſeen on its Belly by the help of the Microſcope, and by the naked Eye; and as ſeen on its Back through the Microſcope.

The Death-Watch, *by M* Ben. Allen, *n.* 245. *p.* 376.

XXIX. In *Auguſt* 1695, I traced a *Death-Watch* by the Noiſe, and found it in a *Copper*-Body; it reſembled dry Dirt in Colour. I found another ſome Years before on a rotten Poſt. This ſmall Beetle had another anſwered it in the ſame Room, and after a Minute's diſtinct beating, would forbear for the other to anſwer.

The Part it bears with, is the extreme Edge of the Face; which I may call the upper Lip, the Mouth being protracted by this bony Part, and lying underneath out of View.

It was $\frac{5}{16}$ of an Inch long, the Colour a dark brown, with Spots, ſomething lighter, irregularly placed, which would not rub off readily. They ſeemed to lie rather athwart the Back, and direct on the Head; as in the ſmall Figure, 194, which is much of the ſame Size with it, and the *Maculæ* *Fig.* 194. are deſigned for the greyiſh Spots. Under the *Vaginæ*, are pellucid Wings, and the Body is of a pullous Colour. The Head appeared large, by reaſon of a large Cap or Helmet, which covered it round, only at the Ear turned up a little; from under this appeared the Head, which was flat and thin; the Eyes forwards, the Lip hard and ſhining, the Bars of the Helmet greyiſh. Two *Antennæ* proceeded from under the Eyes, which, by their meeting on the Breaſt, I conjectured to aſſiſt their Feeding, and to be rather *Proboſces*; and the Helmet to be turned up for hearing-ſake; and the Belly plicated as other Beetles.

The Other Beetle that anſwered it was leſs, and the Marks on the Back, not ſo diſtinct.

By the *Microſcope* I diſcovered the Marks to be thick-ſet ſpots of Hair, of a *Caſtor*-Colour; the Head all hairy, and the Face thick of curled Hair. On the Belly was a little but thin-ſet Hair. The Eyes appeared large, as in the *Fig.* 195. Figure, the Superficies conſiſting of many ſmall ſquares furrowed deep between, and theſe lay in Lines tranſverſly deſcending towards the Noſe. Theſe Eyes were not moveable, but contiguous to the Face, without any Cavity to receive them; and they were very opaque. The *Antennæ* proceeded from under the Eyes; the firſt large Joint having a Cavity, out of which it proceeds at the Sides of the Lip. Between the Eyes the Face riſes in a little Ridge, which is the Noſe, and is ſignified by the light part of the Face. And juſt below it, the Noſtrils are covered by ſtrait pendulous Hair, proceeding from the lower Ridge of the Noſe. Under this Hair, the Cavity is dark. Below the Noſe, the Lip-ſhades ſhew the more depreſt Places. Under this Lip are viſible four *Forcipes*, two of each ſide, to lay hold on its Food.

The Muſca Lupus *in* Virginia, *by Mr.* J. Baniſter, *n.* 198. *p.* 690.

XXX. 1. I have obſerved, that that ſort of Flies which *Mouffet* calls *Muſca-Lupus*, and ſome others, (as the *Tabani*, *Aſili*, &c.) that have but 2 Wings, have growing out of their Body, under each Wing a ſmall flexible *Apex* or *Pointel*, with which they poiſe their Body, and keep it *in Æquilibrio*, as the Dancer on the Rope does with his Pole; for pull theſe off, and their Flight is ſhort and unſteady, nor can they, though they have the uſe of their Wings, guide themſelves ſo, as to keep themſelves from the Ground, or to avoid ſtriking againſt whatever is in their Way.

A Note by ib. *p.* 691.

2. Dr. *Hook* has obſerved theſe *Pendulums*, and deſcribed them in his *Micrographia*, *Obſ.* 38. *p.* 273.

XXXI.

A vivipa-rous Fly; by Dr. M. Liſter n.72.p.217. n.160.p.595

XXXI. I here ſend you a *viviparous Fly*, which is one, if not the very biggeſt of the harmleſs Tribe that I have met with in *England*. I call them harmleſs, becauſe that they are without that hard Tongue or Sting in the Mouth, with which the *Oeſtrum-kind*, or *Gad-Flies*, trouble and offend both Man and Beaſts. This Fly is ſtriped upon the Shoulders, grey and black, and as it were checquered on the Tail with the ſame two Colours. The Female may be known by a Redneſs on the very Point of the Tail. The very latter end of *May* 1666, I opened ſeveral of them, and found two Bags of live white Worms, of a long and round Shape, and black Heads, they moved both in my Hand, and in the unopened Veſicles, backwards and forwards; as being all diſpoſed in the Cells length-ways, the Body of the Female, like a Sheaf. Some ſuch thing is hinted by *Aldrovandus*, and I ſuſpect all of this Tribe to be in ſome meaſure *viviparous*.

Lib. 1. *de In.*

A kind of Worms eating out Stone, by M. de la Voye. n.18.p.321.

XXXII. 1. In a great and very antient Wall of Free-ſtone, in the Benedictines Abbey at *Caen* in *Normandy*, facing ſouthward, there are to be found many Stones ſo eaten by Worms, that one may run his hand into moſt of the Cavities, which are variouſly faſhioned, like the Stones which I have ſeen wrought with ſo much Art in the *Louvre*; in theſe Cavities there is abundance of live Worms, their Excrement, and of that Stone-Duſt they eat. I have taken ſome of theſe living Worms, which I found in the eaten Stone, and put them into a Box with ſeveral Bits of the Stone; leaving them there together for the ſpace of eight Days, and then opening the Box, the Stone ſeemed to me eaten ſo ſenſibly, that I could no longer doubt of it.

Theſe Worms are incloſed in a Shell, which is greyiſh, and of the Bigneſs of a Barley-corn, ſharper at one end than the other. By the means of an excellent Microſcope, I have obſerved, that 'tis all overſpread with little Stones, and little greeniſh Eggs, and that there is at the ſharpeſt end a little Hole, by which theſe Creatures caſt out their Excrement, and at the other End, a ſomewhat bigger Hole, thro' which they put out their Heads, they faſten themſelves to the Stones they gnaw. They are not ſo ſhut up, but that ſometimes they come out, and walk abroad. They are all black about two Lines of an Inch long, and three quarters of a Line large. They are diſtinguiſhed into ſeveral Plyes, and near their Head they have three Feet on each ſide, which have but two Joints, reſembling thoſe of a *Louſe*. When they move, their Body is commonly upwards, with their Mouth againſt the Stone. They have a big Head, ſomewhat flat, and even of the Colour of a *Tortoiſe-ſhell*, browniſh, with ſome ſmall white Hair; their Mouth is alſo big, where may be ſeen four kinds of Jaw-bones, lying croſs-wiſe, which they move continually, opening and ſhutting them like a pair of Compaſſes with four Branches; the Jaws on both ſides of the Mouth are all black; the Nether-Jaw hath a Point like the Sting of a *Bee*, but uniform; draw Threads out of their Mouth with their Fore-feet, uſing that Point to range them, and to form their Shells of them; they have ten Eyes, very black and round; which appear to be bigger than a Pin's Head; they have five of them on each ſide of the Head, ſtanding as in the Figure.

Fig. 196.

2.

Another ſort eating Mortar, ib. p. 322.

2. I have alſo found, that *Mortar* is alſo eaten by an infinite Number of ſmall Creatures, of the bigneſs of *Cheeſe-mites*; theſe have but two Eyes, and are blackiſh; they have four Feet on each ſide pretty long; the Point of their Muzzle is very ſharp, as that of a *Spider*. In old *Mortar* betwixt Stones, that is found in Walls made of Rubbiſh, there is a great Store of them, together with great Plenty of their little Eggs: You may obſerve more of them in Walls expoſed to the South, than in others, and that the Worms that eat the Stone, live longer than thoſe that eat the Mortar; which keep not above eight Days alive. Without a very good Microſcope, and a great deal of Attention, 'tis difficult to ſee them well.

I have ſeen other very old Walls altogether eaten, as thoſe of the Temple at *Paris*, where I could find no Worms: But the Cavities were full of Shells of various kinds, diverſly figured, and turned; all which I believe to be little Animals petrified.

A Scolopendra, *by Mr.* J. Ray, *n.* 74. *p.* 2221

XXXIII. The *Scolopendra*, which is by *Bruerus* aſcribed to *Muffet*, in the latter part of his Chapter *de Julis*, p. 202, I ſaw in the Cloyſters of *Trinity*-College in *Cambridge*, 12 or 13 Years ago.

A Swarm of flying Graſhoppers in Languedoc, *by —— communicated by Mr.* Juſtel, *n.* 182. *p.* 147

Vid. ſupra §. 21, 22, 23.

XXXIV. Theſe Inſects appear to Sight, in nothing different from the common ſort of *Graſhoppers*; but they take their Flight like Birds, which is particular to them. They are much about an Inch in length, of a grey Colour. In the Year 1685, the Earth in ſome Places about *Aramont* in *Languedoc*, near *Avignon*, was covered four Fingers thick with them, in the Morning before the Heat of the Sun was conſiderable: But as ſoon as it began to be hot, they took Wing and fell upon the Corn, eating up both Leaf and Ear, and that with ſuch Expedition, by reaſon of their great Number, that in three hours they devoured the Corn of a whole Field; after which, they again took Wing, and their Swarms were ſo thick, that they covered the Sun like a Cloud, and were whole Hours in paſſing. They flew againſt the Wind, and went over the *Caſtle*, which is very high, and ſeized upon another Field of Corn, which they deſtroyed like the former. After having eaten up the Corn, they fell upon the *Vines*, the *Pulſe*, the *Willows*, and even the *Hemp*, notwithſtanding its great Bitterneſs. Afterwards, about the end of *Auguſt*, they ceaſed flying, and copulated, and the Female ſtruck her Tail into the hard Earth, where ſhe caſt a Foam, and made therewith in the Ground a Hole, as big as that of a *Gooſe-quill*, and about an Inch long, wherein ſhe laid her Eggs, which are much of the ſize of *Millet-ſeed*; there would be ſometimes fifty of theſe Eggs in a Hole, which are ſo covered over with the ſame Earth, that the Water does not get in. After this, all theſe Inſects died, and ſtunk very much. They began to hatch in *April* 1686. In *March*, we thought upon deſtroying their Eggs, which lie not above a Finger's breadth in the Earth; and we took of them 118 Quintals, being 9 Tuns. Since their Hatchings, they have taken above 15 Tuns of the young *Graſhoppers*, which are not yet bigger than Flies: And there are yet a Multitude that have eſcaped us. If this Care had not been taken, there would have been enough of them to have eaten up the Corn of the whole Province.

The Generation of Fleas, *by S* Diacinčto Ceſtone, *n*.249. *p*.42.

XXXV. *Fleas* bring forth Eggs (or a ſort of *Nits* ;) from theſe Eggs are hatched Worms ; theſe Worms make to themſelves Bags like *Silk-Worms* ; and from out of theſe Bags come *Fleas*. The Eggs they depoſite on Dogs, Cats, Men and other Animals infeſted with them ; or in Places where they ſleep, which being round and ſmooth, ſlip ordinarily ſtreight to the Ground, or fix themſelves on the Plyes, or other Inequalities of the Coverlets and Cloaths. From theſe are brought forth white Worms of a ſhining Pear-colour, which feed themſelves on the Bran-like Subſtance which ſticks in the Combs when Puppies are combed to take out the *Fleas*, or with a certain downy Subſtance, that is found in the Plyes of Linnen-Drawers or other ſuch *Fig*.197. like Excrement. They come in a Fortnight to the bigneſs of *Fig*. 197. and are very lively and active, and if they have any Fear, or if they be touched, they ſuddenly roll themſelves up, and make as it were a Ball. A little after, they come to creep, after the manner of the *Silk-Worms* that have no Legs, with a briſk and very ſwift Motion. When they are come to their uſual bigneſs they hide themſelves the moſt they can, and bringing out of their Mouths the Silk, they make round themſelves a ſmall Bag, white within as Paper, but without always dirty, and foul'd with Duſt. The Bags are to *Fig*.198. the naked Eye of the bigneſs of *Fig*. 198, without magnifying. In other two Weeks in the Summer-time, the *Flea* is perfectly formed ; without that the Worm quits its *Exuviæ* in its Bag, as do the *Silk-Worms* ; and as do all *Caterpillars*, which leave in the ſame their *Exuviæ*. The *Flea*, ſo long as it is incloſed in the Bag, is Milk-white, altho' it has its Legs ; but two Days before it comes out, it becomes coloured, grows hard, and gets Strength, ſo that coming ſpeedily out, it ſtreight leaps away.

Fig.199. Repreſents the *Eggs*. *Fig*. 200. The *Worm*. *Fig*. 201. The Bag, *Fig*. 202. The *Flea*. But all magnified by the *Microſcope*.

The Emmet *or* Ant ; *by Sir* Edmund King, *n*. 23. *p*. 425.

XXXVI. There have occurred to my Obſervation but three ſorts of *Ants*, commonly without Wings ; *viz*. very black, dark-brown and *Philemort*. Each kind inhabit by themſelves in their ſeveral Banks, two ſorts ſeldom or never being found together ; and if either of the other two ſorts be put into the *black Ants* Bank, 'tis worth obſerving what Enmity there is betwixt theſe little Creatures, and with what Violence the black ones will ſeize on the red, never leaving to pinch them on the Head with their *Forceps*, or Claws, till they have killed them upon the place ; which done, they will carry them Dead out of the Field, from their Bank. But if you put *black Ants* into a Bank of the red, the black ſeem to be ſenſible of the ſtrangeneſs of the Place they are in, that there they will not meddle with the red ; but as if they were frighted, and concerned for nothing but Self-preſervation, run away.

Upon opening of theſe Banks, I obſerve firſt, a white Subſtance, which to the bare Eye looks like the ſcattering of fine white Sugar or Salt, but very ſoft and tender. And if you take a bit of it, as big perhaps as a *Muſtard-Seed*, and lay it on the Object-Plate of a good *Microſcope*, you may by opening it with the Point of a Needle diſcern many pure, white and clear Appearances in diſtinct Membranes all Figured like the leſſer ſort of Bird's Eggs, and as clear as a Fiſh's Bladder. This Subſtance, as it hath been juſt now deſcribed, I find in the *Ants* themſelves; which I take to be the true Ants-Eggs: It being obvious to the Obſervation, that wherever this is uncovered, they make it their Buſineſs to carry it away in their Mouths to ſecure it, and will, after you have ſcattered it, lay it on a heap again, with what ſpeed they can. I obſerve, they lie in Multitudes upon this (if I may ſo call it) Spawn of theirs: And after a little time every one of theſe ſmall Adherences is turned into a little *Vermicle*, as ſmall as a *Mite*, hardly diſcerned to ſtir. But after a few Days more, you may perceive a feeble Motion of Flexion and Extenſion, and they begin to look yellowiſh and hairy, ſhaped very like a ſmall Maggot: And ſo keeping that ſhape, grow almoſt as big as an *Ant*, and having every one a black Spot on them. Then, they get a Film over them, whitiſh and of an Oval-ſhape; for which Reaſon, I ſuppoſe, they are commonly called *Ants-Eggs*; which yet (to ſpeak properly) are not ſo.

I have opened many of theſe, vulgarly call'd *Ants-Eggs*, I mean the leſſer ſort, (for there are ſome as big as a Wheat-Corn, others leſs than a Rye-Corn) and in ſome I find only a Maggot to appearance juſt as was deſcribed before. In others, I find a Maggot, beginning to put on the ſhape of an *Ant* about the Head, with two little yellowiſh Specks, where the Eyes are deſigned; in others, a further Progreſs, and furniſh'd with every thing to compleat the Shape of an *Ant*: But wholly traſparent, the Eyes only excepted, which are then as black as black Bugles. But when they newly put on this Shape, I could never diſcern the leaſt Motion, in any one part of the little Creatures, whereof the Reaſon may perhaps be the Weakneſs of their Fibres; for after a little more time, when they begin to be browniſh, they have Strength to ſtir all their Parts. At laſt I met with ſome of thoſe reputed Eggs, which being carefully opened by me, I took out of ſeveral of them every way perfect and compleat *Ants*, which did immediately creep about, among the reſt, no way differing from many other *Ants*, but by a more feeble Motion of their Limbs. And this I took for a clear Demonſtration of what I deſigned, which was to know, that the Film does only cover the Maggot while ſhe is transforming into an *Ant*, and fit to ſhift for herſelf. The black Speck, that is at one end of every ſuch reputed Ant's Egg, I ſuppoſe to be caſt out of the Maggot in her Transformation: Since after it puts on the ſhape of an *Ant*, the Speck is quite gone, and the whole Body of the *Ant* pure clear; ſince alſo this Speck at the end of the ſaid Egg, lies always cloſe to the *Anus* of the included *Ant*.

It is obſervable, how upon a breaking up of their Banks, they make it their buſineſs immediately to carry their Young out of Sight again; laying the ſeveral ſorts of them in ſeveral Places and Heaps; the which if you mingle again, or ſcatter, you ſhall, laying but ſome bits of Slate, or the like, in any place they may come to, and get under, after a few Hours ſee all the *Vermicles* and vulgarly called Eggs, laid in their ſeveral and diſtinct Parcels under ſuch Pieces of Slate, *&c.* Provided the place be not ſo cold as to chill their Limbs; which if it be, by being brought to the Fire, they will ſoon recover their Strength, and fall to their buſineſs again, of ſecuring their little Ones. They know all the ſorts of their Young ſo well, that you cannot deceive them though you may with Fine Sugar, Salt, or the Crumbs of very White Stale Bread, ſcattered in the Mould, where their firſt true Eggs are, as I call them, be miſtaken your ſelf, yet the *Ants* will not, nor touch a bit of what is not their own Offspring.

I have obſerved in Summer that in the Morning they bring up thoſe of their Young (that are vulgarly call'd *Ants-Eggs*) towards the top of the Bank: ſo that you may, from ten in the Morning until five or ſix in the Afternoon, find them near the top; eſpecially about one, two, or three of the Clock, and later, if the Weather be hot; when for the moſt part they are found on the South-ſide of the Bank. But towards ſeven or eight at Night, if it be Cool or likely to Rain, you may dig a Foot deep before you can find them.

The Acid Juice of Piſmires, *by Mr.* J. Wray, *n.* 68. *p.* 2003.

XXXVII. Dr. *Hulſe* in *Aug.* 1670, ſent me theſe Obſervations; “ Bare “ an *Ant-Hill* with a Stick, and then caſt *Cichory-flowers* upon it, and you “ ſhall ſee the *Ants* creep very thick over them; now as they creep, they “ let fall a drop of Liquor from them, and where that chanceth to light, “ there you ſhall have in a Moment a large red Stain. Sometimes they “ will be a pretty while before they diſcolour them, and at other times, “ they will do it ſuddenly. At the firſt I gueſſed that being vext, by ſtir“ ring their Hill, they might thruſt their Stings into the Flowers, and “ through them convey that ſharp Liquor; but by bruiſing them, and rub“ bing the expreſſed Juice againſt the Flowers; I find they will be equally “ ſtain'd. 'Tis a thing well known, that *Ants*, if they get into Peoples “ Cloaths, and ſo to their Skin, will cauſe a Smart and Tingling, as if they “ were nettled; which I conceive is done by letting fall the forementioned “ corroſive Liquor, rather than by Stinging.

“ To what ſort of Liquor to refer this Juice, I know not. I dropt Spirit “ of Salt, and Oil of Sulphur upon the Flowers; but they did not cauſe “ them to change Colour. I likewiſe put Salt of Tartar upon them, and “ dropt thereon a little Spirit of Salt, which cauſed a ſufficient Fermentation; “ but prevailed not to change the Colours of the Flowers in the leaſt.

“ This Obſervation holds true, not only in *Cichory-flowers*, but alſo *Lark*“ *Spur*, *Borage*, and all others of a Blue-colour.”

Some Years ſince Mr. *Sam. Fiſher* of *Sheffield*, made me acquainted with theſe Experiments, *viz.* “ If with a Staff, or other Inſtrument you ſtir an “ Heap of *Ants*, (eſpecially *Horſe-Ants*) ſo as to anger them, they will let “ fall thereon a Liquor, which if you preſently ſmell to, will twinge the “ Noſe like newly diſtilled Spirit of Vitriol.

“ A

“ A Weak Spirit of *Piſmires*, will turn *Borage-flowers red* in an Inſtant;
“ Vinegar a little heated will do the like. *Piſmires* diſtill'd by themſelves,
“ or with Water, yield a Spirit, like Spirit of Vinegar, or rather like the
“ Spirit of *Viridi Æris*; Lead put into this Spirit, or Fair Water, with the
“ Animals themſelves being alive, maketh a good *Saccharum Saturni*. Iron
“ put into the Spirit, affords an *Aſtringent Tincture*, and by a *Repetition*, a *Crocus*
“ *Martis*. Take *Saccharum Saturni* thus made, and diſtil it, and it will af-
“ ford the ſame Acid Spirit again, which the *Saccharum Saturni* made with
“ Vinegar will not do; but returns an inflammable Oil with Water, and no-
“ thing that is *Acid. Saccharum Saturni* made with *viridi Æris*, doth the ſame
“ (in this reſpect) with that made with Spirit of *Piſmires*. When you put
“ the Animals into Water, you muſt ſtir them to make them angry, and then
“ they will ſpirt out their acid Juice. No Animal that we ever diſtilled
“ (he ſpeaks of his Brother and himſelf) except this, yields an acid Spirit,
“ but conſtantly an Urinous; and yet we have diſtilled many, both Fleſh,
“ Fiſh and Inſects.”

In Dr. *Hulſe*'s Account, where he ſaith, that *Spirit of Salt, and Oil of Sulphur dropped upon Cichory-Flowers, did not cauſe them to change Colour*, it is to be underſtood of the Flowers entire and unbruiſed: For any blue Flowers being a little bruiſed, and then a Drop of Spirit of Salt, or any other Acid Spirit let fall thereon, will turn inſtantly red. The Reaſon is obvious; for that the Leaves of the Flowers (as all the other parts of the Plant) being inveſted with a Skin or Membrane, the Liquor dropp'd thereon cannot eaſily penetrate it, and ſo commix itſelf with the interiour Juice or Pulp. Hence it is, that if theſe Flowers be put into cold Vinegar, eſpecially if the Weather be cool, they will not change Colour for a conſiderable time; but if you heat the Vinegar, they will change immediately.

2. Having obſerved that a *Piſmire* bruiſed and ſmelt to, emits a ſtrange fiery and piercing Savour, like the Leaf of the Herb, by Botaniſts call'd *Flammula*, broken at one's Noſtrils, I have by this means found an Inſect, which I ſuſpect, may yield an acid Liquor, as well as the *Piſmire*; and that is the *long* and *round-bodied red-colour'd Julus* diſtinguiſhed from all other *Multipeds*, in that their innumerable Legs are as ſmall as a Hair, and white, and in going they are moved like Waves; not rare amongſt dry Rubbiſh; no *Scolopendra*, ours being an harmleſs Inſect, and that armed with dangerous *Forcipes*. The Body of this *Julus* being bruiſed, ſtrikes the Noſtrils exceedingly fiercely.

Another Inſect yielding an acid Juice, by Dr. M. Liſter, ib p. 2067.

XXXVIII. *Sep.* 2, 1671, I found in a ſandy Ditch-bank about a Mile and an half from *York*, in the high Road to *London*, a ſort of exceeding ſmall *Piſmires* (by which Note alone I think they may be ſufficiently diſtinguiſh'd from all, at leaſt, that I have ſeen.) Thoſe without Wings, were of a Light-yellow, or Flaxen, and being broken at one's Noſtrils they emitted, like others, an acid or ſowre Scent, but thoſe of the ſame Bank with Wings, were Coal-Black, and thoſe bruiſed and ſmelt to, emitted a fragrant Smell like Muſk, And an Apothecary in *York*, famous for his Diligence in Chymical Operations,

Muſk-ſcented Ants, *by Dr.* Liſter, n. 77. p. 300. *Vid. ſuprà* §. XXVI. & XXVII.

did compare them (unſeen and not yet made known to him) to an Excellent *Balſam*, he is wont to prepare.

A Table of SPIDERS *found in* England, *by Dr.* M. Liſter, *n.* 72. *p.* 2175.

Of Spiders.

They either *ſend forth Threads*; ſuch as are thoſe who either *weave* to catch their Prey;

or make the *round Nets*, and are in Number IX.

1. *The Yellowiſh-Spider*, with the Belly a little pointed and crooked.
2. *The Red-Spider*, or *Croſs-bearer*, having on each Side at the upper Part of the Belly a kind of prominent Tubercle.
3. *The Aſh-coloured Spider*, having the Figure of the Buttock divided into five Parts, almoſt ſeparated from one another, and very full.
4. *The Yellowiſh-Spider*, of a leafy Colour, and marked in the Buttocks with four white Spots.
5. *The Blackiſh-Spider*, with the Buttocks painted like the Leaf of an Oak.
6. *The Greeniſh-gelded Spider*, with a long ſlender Belly.
7. *The Aſh-coloured Spider of the Woods*, with the Belly pointed, or three-ſquare.
8. *The Green-Spider*, with the *Tail* marked above with *black Spots*, and the *Anus* of a *Saffron-Colour*.
9. *The Black Croſs-Bearer Spider*, with a full Belly.

Or the Globular Nets, N. IV.

10. *The Variegated Spider*, with a globular Belly;
11. *The Red-Spider*, having the Top of its round Buttocks radiated like a Star.
12. *The Black Houſe-Spider*.
13. *The Leaſt Aſh-coloured Spider*, marked with *a black Spot* upon the *Top of the Hips*.

Or Webs, or Sheets, N. VIII.

14. *The Yellowiſh-Spider*, hairy, with long Feet, and of the Domeſtick Kind.
15. *The Blackiſh-Spider*, with a large Spot on the Top of its Buttocks, which is ſtriped. This too is Domeſtick.
16. *The Sooty-Spider of Craven*, ſhining remarkably, and having its Tail bifurcated.
17. *The Yellowiſh-Spider*, marked in the Buttocks with a Train of four-ſquare *blackiſh Spots*, and having oblique *Yellowiſh-Streaks* on the Sides of each Buttock.
18. *The greateſt Aſh-coloured Spider*, with a bifurcated Tail.
19. *The Black or Cheſnut-coloured Spider*, ſmooth, and its Buttocks here and there very bright.
20. *The Aſh-coloured Spider*, ſoft, and having a pretty broad blackiſh-red Spot upon its Belly, which is marked with oblique Streaks.
21. *The Spider* for the moſt Part *livid*, without any particular Spots or Streaks upon its Belly, and therefore it does not weave (unleſs

the throwing out of Threads and its Flight refer to that ;) though it can upon Occaſion, *viz.* Webs to preſerve its Fetus, or againſt the Winter ; but they hunt the Flies openly ; and they are either, *The Lupi*, N. V. And theſe with all the former have eight Eyes.

22. *The Reddiſh-Spider*, little, and very ſwift.
23. *The Crab-like Spider*, with Eyes of a Violet, Purpliſh Colour, and ſlow.
24. *The Aſh-coloured Spider*, with the Belly ſtreaked in a wavey manner, remarkably tall, and peaked.
25. *The Brown-Spider*, with the Belly obliquely ſtreaked.
26. *The Black-Spider*, Inhabitant of the Woods.

Or *The Phalangia*, or *jumping-Spiders*, N. III. Theſe have only ſix Eyes.

27. *The Aſh-coloured Spider*, variegated with a Silver-Colour and Black.
28. *The Yellowiſh-Spider*, with Eyes reſembling an *Emerald* ; and having three ſmall Saffron-coloured Streaks along the Buttocks.
29. *The Reddiſh-Spider of Craven*, or the Spider of the Heath, or of the Rocks.

Or ſuch as ſend out no Thread at all, as are moſt of thoſe which have very long and ſlender Legs ; and theſe have only two Eyes, and Claws upon their fore Legs. N. IV.

30. *The Red-Spider*, untufted, living in Troops.
31. *The Aſh-coloured* Spider, tufted.
32. *The variegated black and white Spider*, exceeding ſmall, and living in the Woods.
33. *The Saffron-coloured Spider*, as I think it is commonly called, in *England*, a *Tant*.

XL. 1. I have diſcover'd, that all *Spiders* that ſpin a Thread, (thoſe which we call *Shepherds*, or *long-legg'd-Spiders*, never do,) are the Makers of thoſe *long Threads in the Air in Summer*, and eſpecially towards *September*, ſo much wondred at, and in ſuch infinite Quantities every where. I exactly marked all the ways of Weaving, uſed by any ſort of them, and in thoſe admirable Works, I ever noted, that they ſtill let down the Thread they made uſe of, and drew it after them.

Spiders darting their Threads into the Air, and ſwimming in it, by Dr. Liſter, n. 50. p. 1014.

At length in nearly attending on one that wrought a Net, I ſaw him ſuddenly in the mid-Work to deſiſt, and turning his Tail into the Wind to dart out a Thread, with the Violence and Stream we ſee Water ſpout out of a Spring. This Thread, taken up by the Wind, was in a Moment emitted ſome Fathoms long, ſtill iſſuing out of the Belly of the Animal ; by and by the *Spider* leapt into the Air, and the Thread mounted her up ſwiftly. After this firſt Diſcovery, I made the like Obſervation in almoſt all the ſort of *Spiders*, I had before diſtinguiſhed ; and I found the Air filled with young and old, ſailing on their Threads, and undoubtedly ſeizing *Gnats* and other Inſects in their Paſſage ;

ſage; there being often manifeſt ſigns of ſlaughter, as Legs, Wings of *Flies*, &c. on theſe Threads, as in their Webs below.

One thing yet was a wonder to me, *viz.* that many of theſe Threads, that came down out of the Air, were not ſingle, but ſnarled, and with Complicable woolly Locks, now more, now leſs, and that on theſe I did not always find *Spiders*, though many times I had found two or three upon one of them; whereas when they firſt flew up, the Thread was ſtill ſingle, or but little tangled, or it may be thicker in one place than another. In the end by good Attention, I plainly found them to get to the Top of a Stalk or Bough, or ſome ſuch like thing, where they exerciſe this darting of Threads into the Air; and if they had not a mind to ſail, they either ſwiftly drew it up again, winding it up, with their Fore-feet over their Head into a Lock, or break *it* off ſhort, and let the Air carry it away. This they will do many times together: And you may ſee of them that have Chains of theſe Locks or ſnarled Thread before them, and yet not taken Flight.

Again, I found that after the firſt Flight all the time of their Sailing, they make Locks, ſtill darting forth freſh ſupplies of Thread, to ſport and ſail by.

It is further to be noted, that theſe complicated Threads, are much more tender than our Houſe-Webs.

In Winter and at *Chriſtmas* I have obſerved them buſy a-Darting: But few of them ſail then, and therefore but ſingle Threads only are to be ſeen. And beſides, they are but the young Ones, of laſt Autumn's Hatch, that are then employed; and it is more than probable, that the great *Ropes* of Autumn are made only by the great Ones, and upon long Paſſages and Summer-Weather, when great Numbers of *Prey*, may invite them to ſtay longer up.

By Dr. Hulſe, n. 65. p. 2105. 2. I have ſeen Spiders ſhoot their Webs three Yards long before they begin to ſail; and then they will, as it were, fly away incredibly ſwift. Which *Phænomenon* doth ſomewhat puzzle me; ſeeing ſometimes the Air doth not move a quarter ſo faſt as they ſeem to fly. Moſtly they project their Threads ſingle, without dividing or forking at all to be ſeen in them. Sometimes they ſtill ſhoot the Thread upward, and will mount with it in a Line almoſt Perpendicular; and at other times they project in a Line Parallel to the Plain of the Horizon; as you may often ſee by their Threads that run from one Tree to another, and likewiſe in Chambers from one Wall to another.

I confeſs, this Obſervation at firſt made me think, that they could fly; becauſe I could not perceive, how a Thread could be drawn ſo parallel to the Horizon between two Walls or Trees, as abovesaid, unleſs the Spider flew through the Air in a ſtraight Line.

Fig. 205. The way for forking their Threads, is expreſſed by the Figure. What Reaſon ſhould be given of this Dividing, I know not, except that their Threads, being thus winged, become better able to ſuſtain them in the Air.

They will often faſten their Threads in ſeveral Places to the Things they creep upon: The manner is by beating their Tails againſt them as they *Fig.* 204. creep along, which may be underſtood by the Line *a*, *b*. By this frequent Beating in of their Thread among the Aſperities of the Place, where they creep, they either ſecure it againſt the Wind, that it be not eaſily blown away; or elſe whilſt they hang by it, if one ſtick breaks, another holds faſt, ſo that they do not fall to the Ground.

By Mr. J. Wray, ib.

3. I had the firſt Notice of this Darting of *Spiders*, from Dr. *Hulſe*, which was not long after communicated to me by Mr. *Liſter*; nor is it any great Wonder, that inquiſitive Perſons, applying themſelves to obſerve, and conſider the ſame Subjects, ſhould make the ſame Diſcoveries.

By —— *ib. p.* 2104.

4. Mr. *Liſter* intimates in a later Letter, that Mr. *Wray* knew nothing of his having obſerved the darting of *Spiders*, no more than he knew that either Mr. *Wray* or any body elſe had obſerved it, until ſuch time as he occaſionally ſent Mr. *Wray* a Catalogue of our *Engliſh-Spiders*; upon which Subject Mr. *Wray* put this, among other Queſtions, Whether he had obſerved the Darting of Spiders?

Whence it appears, that this Obſervation is as well Mr. *Liſter*'s as Dr. *Hulſe*'s.

By Dr. Liſter, n. 160. *p.* 192.

5. I take the Forking of ſome Threads (for Dr. *Hulſe* excepts the moſt) to be meerly accidental, even as it is to our Hair: Neither do I think that any ſuch thing is deſignedly done by the Animal, and for as much as I have obſerved, Spiders Threads of themſelves are exceeding ſlick and ſmooth. There is indeed a dividing in the Projection of the Threads of many ſorts of Spiders, and eſpecially among thoſe which we diſtinguiſh by the Name of *Lupi*, which Tribe is moſt frequent, and particularly delighted in Sailing, yet this Dividing is much of another Nature than Forking. Theſe *Lupi* will dart a whole *Stamen* or *Sheaf* at once, conſiſting of many Filaments: Yet all of one length, all divided each from the other, and diſtinct until ſome chance either ſnap them off, or entangle them. But for the moſt part you may obſerve, that the longer they grow, the more they ſpread, and appear to a diligent Obſerver, like the numerous Rays in the Tail of a *Blazing Star*. As for that which carries them away in the Air, ſo ſwift off hand, it is, as I have already hinted, partly their ſudden Leap, and partly the length and number of the Threads projected, the Stream of the Air and Wind beating more forcibly upon them: And thus we ſee a Rope that unexpectedly ſlips, comes home with a ſeeming Violence, and partly (and that much too) the Poſture and Management of their Feet, which, at leaſt by ſome ſort of them, I have obſerved to have been uſed very like Wings or Oars, the ſeveral Legs like our Fingers, being ſometimes cloſe jointed, and other times opened, again bent, or extended, *&c.* according to the ſeveral Neceſſities and Will of the Sailer. To fly they cannot be ſtrictly ſaid, they being carried into the Air by external Force, but they can, in caſe the Wind ſuffer them, ſteer their Courſe, and perhaps mount and deſcend at Pleaſure; and to the purpoſe of Rowing themſelves along the Air, 'tis obſervable, that they ever take their Flight backwards, that is, their Head looking a contrary way, like a Sculler upon the Thames. It is ſcarce credible to what Height they will mount: Which yet, is preciſely true, and a thing eaſily to be obſerved by one that ſhall fix his Eye, ſome time on any part of the Heavens, the white

Webs at a vaſt Diſtance very diſtinctly appearing from the Azure Sky; but this is in *Autumn* only, and that in very fair and calm Weather.

The Innoxiouſneſs of Spiders and Toads, by Dr. Nath. Fairfax, *n.* 22. *p.* 392.

XLI. S. *Redi* having affirm'd, that Creatures reputed *venomous* are indeed no *Poiſons* when ſwallowed, tho' they may prove ſo when put into Wounds. Mr. *Nath. Fairfax*, for Confirmation thereof, alledges Examples of ſeveral Perſons well known to him, (himſelf alſo having been an Eye-witneſs to ſome ſuch Experiments) who have frequently ſwallow'd *Spiders*, even of the rankeſt kind, without any more Harm than happens to *Hens*, *Robin-red-Breaſts*, and other Birds, who make *Spiders* their daily Commons. And having made mention of ſome Men that eat even *Toads*, he adds, that tho' a *Toad* be not Poiſon to us in the whole, yet it may invenom outwardly, according to ſome Parts ſo and ſo ſtirr'd; an Inſtance whereof he alledges in a Boy, who ſtumbling on a *Toad*, and hurling Stones at it, ſome Juice from the bruiſed *Toad* chanced to light upon his Lips, whereupon they ſwell'd, each to the thickneſs of about two Thumbs; and he neglecting to uſe what might be proper to reſtore them, they have continued in that miſ-ſhapen ſize ever ſince.

Spiders tinge Water of a Sky-Colour, by Dr. Fairfax, *n.* 12. *p.* 219.

XLII. Mr. *Nath. Fairfax* relates that a *Spider* bruiſed into a ſmall Glaſs of Water, tinged it ſomewhat of a Sky-colour; and he is informed, that a Dozen of them being put in, they would dye it almoſt a full Azure.

The Anatomy of a Rattle-Snake, *by Dr.* Edw. Tyſon, *n.* 144. *p.* 25.

XLIII. Upon the Diſſection of a *Rattle-Snake*, which was ſent alive from *Virginia*, to Mr. *Hen. Loades*, a Merchant in *London*, I find both its external and internal Parts ſo conformable in almoſt all Reſpects to thoſe of a *Viper*, that I have taken the Liberty of placing it in that Claſs, and from the *Rattle*, which ſufficiently differences it from other *Serpents*, of naming it *Vipera caudiſona*.

It was four or five Inches long, the Girth of the Body in the largeſt Place, which was the Middle, was ſix and a half Inches; the Girth about the Neck three Inches, near the *Rattle* two Inches, the Head flat on the top as in the *Viper*, and by the Protuberance of the *Maxillæ*, ſomewhat repreſenting the Head of a bearded Arrow, at the Extremity of it were the Noſtrils; between them and the Eyes but ſomewhat lower, were two other Orifices, which I took for the Ears; but after found, they only led into a Bone that had a pretty large Cavity, but no Perforation.

Fig. 209. *a.*

Fig. 209. *b.*

The Eye was round, about a quarter of an Inch Diameter: There was a large Scale jetting over the Eye, which ſeemed to ſerve as a *Palpebra* for defending it from any thing falling on it; but I could not perceive 'twas capable of cloſing, though inwards it ſeem'd to have a *Membrana Nictitans*, which moves any Duſt that might adhere to the Eye.

The Scales on the Head were the ſmalleſt of any; thoſe on the Back larger; and ſo proportionably greater, to the biggeſt part of the Body, and ſo diminiſhing thence again to the ſetting on of the *Rattle*, all in Figure ſomewhat reſembling *Parſnip-Seeds*. Their Colour was various, thoſe on the Head like the Colour of the Feathers on the Back of a *Green Finch*, ſpeckled with ſmall black *Spots*, whereof there were four larger and more remarkble: Thoſe on the Back were of a dark *Feuillemort*, a black and a darkiſh Yellow, and ſpeckled, making a curious Chequer or Dappling on the Back by this intermixture of Colours; but as they grew nearer the Tail, they became darker, and at laſt almoſt black. The *Scales* on the Back had an edged riſing in the middle, which was ſtill leſs protuberant as they grew nearer the Sides, where they were flat.

The Belly ſeem'd flat, covered with long Scales of a yellowiſh Colour, ſpeckled black. From the Neck to the *Anus*, we numbered 168; beyond the *Anus* were two half Scales, thence nineteen whole Scales of a black Lead-Colour, with yellowiſh Edges; from thence to the *Rattle*, ſix Orders or Rows of ſmaller Scales of the ſame Colour. The Scales of the Belly were joined to each other by diſtinct Muſcles; the lower Tendon of each Muſcle being inſerted upon the upper Edge of the following Scale, and the other Tendon of the ſame Muſcle inſerted about the middle of the foregoing Scale. Theſe Muſcles *Fig.* 205. s s s. were more fleſhy towards the Middle of the Scale, and then its Fibres did run obliquely aſcending. To each ſide was appropriated a Rib, whoſe Point did join with the Extream of it, which muſt much advantage the uſe Nature ſeems to deſign them for, by ſtrengthning them to perform their Reptile Motions; for the Scales are ſo many Feet, which being free and open downwards they thereby take hold of the Ground, and ſo contract their Body forwards, and then ſhoot out again; and ſo perform their Motion. Hence it is, that on Rocks their Motion is much quicker than on the Earth, or Plains, becauſe here they have the firmer Footing; but in ſoft Ground, tho' their Belly be flat, yet they can contract it to an *Ellipſis*, or an Acute Angle, that ſo they may take the deeper Hold, as I have obſerved in a Viper. This Coat of Armour (for their Defence) is ſo curiouſly contrived, that tho' it covers the whole Body, yet by its frequent Jointings it admits of all Motions.

Having placed this *Rattle-Snake* on its Back, we opened it, and obſerved that the Tendons of the *Abdominal Muſcles* made a *Linea alba*, in the midſt *Fig.* 205. r r r. of the Scales of the Belly, where likewiſe did run a large Blood-Veſſel, ariſing from the *Vena Cava* towards the lower part of the Liver.

The Wind-pipe, which is common to it with the Viper-kind, as ſoon as it enters the Breaſt, preſently meeting with the Lungs, conſiſts only of *Fig.* 205. a a a. *ſemi-annular Cartilages*, which being joined at both Ends to the Membrane of the Lungs, inwardly is quite open, and immediately tranſmits the Air to the *Veſiculæ* of the Lungs: For dividing the Wind-pipe, we perceived it eaſily extended above $1\frac{1}{2}$ Inch wide; whereas before it meets with the Lungs the *Cartilages* are Annular. The *Trachæa* or Wind-pipe was twenty Inches long, *Fig.* 203. a a a. terminating near the Heart, and Beginning of the Liver, and reaching to that Part of the Lungs which made the Great *Bladder*. The *Cartilages* of the *Trachæa*, near the Beginning were $\frac{3}{4}$ of an Inch, but towards the End half of an Inch, and lying flattiſh from End to End. Theſe Cartilages were not ſo diſtinct as in other Animals, but often running into one another.

Fig. 205. The Lungs begin from the Throat, and run down three Foot in length ; the upper part of them that lay in the fore part of the Body for the length of a Foot, and did reach to the Heart, was made of ſmall *Veſiculæ*, or Cells, like the Lungs of a *Frog* ; but from the frequent Branchings and Checquer of the Blood-Veſſels there, appeared of a florid red. This Part tapers proportionably to the Body ; the loweſt part of it near the Heart moderately blown, was in Compaſs five Inches and a half ; a little lower, for the ſpace of four Inches, the Cells gradually diſappeared, ſo that they ſeemed at laſt to form only a Reticular *Compages* of *Valvulæ conniventes* on the inſide of the Membrane of the Lungs, and the Compaſs of the greateſt Place here, was about ſix Inches *Fig.*205.*aaa* and half; but from thence to the end of the Lungs, was only a large Bladder, without any Cells, compoſed of a thin, but a ſtrong tranſparent Membrane, the Compaſs of which, blown as the former, was eight Inches and a half.

The Lungs of the *Salamandra Aquatica*, and ſome other Animals, are only two large Bladders ; in the *Frog*, *Crocodile*, &c. are two large Lobes, fill'd with *membranous Veſiculæ*, or Cells. Our *Rattle-ſnake*, and all that Family, tho' they have but one Lobe of Lungs, yet in that they compriſe the two former ſorts ; the fore Part being filled with numerous *Veſiculæ*, the latter an entire large Bladder.

In the *Land Tortoiſe* there are two Lobes, one on each ſide ; but theſe are ſub-divided into ſeveral others, according to the Partitions of the Ribs that are fixed to the Shell, and they lie chiefly in the Belly, that is, the loweſt Part of the Body. But what I would remark is, that where the *Bronchiæ* firſt enter theſe Sub-diviſions, 'tis *Reticulous* ; then they form a large Cavity ; ſo that in theſe Animals, where the *Nixus* of Reſpiration is not ſo frequent, Nature provides a ſufficient Store-houſe for this ſo neceſſary a *Pabulum Vitæ*, in theſe large Bladders, whence 'tis diſpenſed according to the Exigency of the *Oeconomia Animalis*. For the *Tortoiſe*, *Viper*, *Rattle-Snake*, *Frogs*, *Toads*, &c. which ſleep a great part of the Year, as before they betake themſelves to this Repoſe, they take in their Store of Food, ſo perhaps that of Air too ; a more conſtantly requiſite Supply of Life. For when thus ſtupidly aſleep, and ſometimes to all appearance dead, it may be queſtioned whether they have any Motion of thoſe Parts, which is required in drawing in freſh Air in Inſpiration. But ſince their Life here is ſo imperceptible and ſmall, this Stock may be ſufficient, the Decay being ſo little. So, the *Salamandra aquatica*, that lives under Water, for Lungs has two large Bladders, not unlikely for this Reaſon, that it might not be forced ſo often to raiſe itſelf out of the Water to breathe in freſh Air, when the former is ſpent and decayed.

In a *Viper* I lately diſſected, (which remained alive ſome Days after the Skin, and moſt part of the *Viſcera* were ſeparated) I obſerved the Lungs all this while not riſing and falling, as in Inſpiration and Expiration, but conſtant, equally extended with Air, and that as ſoon as it died, it expired, and they fell. But the Stomach was empty, and I doubt not, was ſo ſome conſiderable time before, as was the *Rattle-ſnake's*, which for four Months at leaſt had eaten nothing, ſo that altho' they can live ſo long without Food, yet Nature is mighty provident in ſupplying them with Air, in beſtowing on them ſo large Receptacles for receiving it. So the *Ephemeron*, the *Silk-worm*, and other *Butterflies*, which all their Life-time, when in that State, do not eat, or take in any Food, yet have their *Bronchiæ* or Lungs remarkably large and numerous; as if they were ſufficient alone for maintaining their Life, for if they be occluded with Oil, or otherwiſe, they are ſtrait ſuffocated, and die convulſed.

The *Oeſophagus*, or *Gula*, which ſerves only in moſt other Animals for tranſmitting the Food into the Stomach, ſeems here to be intended by Nature for ſomething more; for upon blowing up this Part, I obſerved two large Swellings, nor was the true Stomach capable of that Extention as theſe were. The whole length of the *Oeſophagus* was two Foot three Inches and half; the length of the proper Stomach five Inches, lying in a ſtrait Line with the *Oeſophagus*, but thicker than it, having a remarkable Coat more on the inſide, eaſily diſtinguiſhable by its Colour, Subſtance, and *Plicæ*, and jetting over the inſide of the Gullet, and in all reſpects as in the *Viper*. From the *Pylorus*, the *Ductus* ſtreightned again for half an Inch, and then formed a large Inteſtine, which afforded a pleaſant Sight, by the weaved *Rugæ* of its inward Coat; which Gut, after ſome ſmall Windings, ended at laſt in the *Rectum*, whoſe Capacity was much leſs than the former. In the Stomach and Gut, I obſerved abundance of *Lumbrici Tertes*, which is a Diſeaſe *Vipers* likewiſe are ſubject to. I take the ſwelling in the Gullet to perform the ſame uſe in theſe Animals as the Crop in *Birds*, and the Paunch in *Quadrupeds*; they being convenient Receptacles for retaining what Food the Stomach cannot yet well receive; and here it ſeems the more requiſite, ſince they feed but at one time of the Year. And ſince in that promiſcuous Food they take in, which they ſwallow always whole, there are often ſome parts unfit to be digeſted, and therefore to be returned again, the Gullet here being very long, and upon that Account incommodious for this Action; Nature has provided theſe Swellings in it, where it may be reſpited, till recruiting its Force, it gives them another Lift, and upon a third Effort, at laſt wholly ejects them. And if what is confidently reported by many be true, that on Occaſion of Danger, they receive their Young into their Mouths, theſe are fit Places for Receiving them.

Fig. 205. *df*.

Fig. 205. *g*.

Fig. 206. *eee*.

Fig. 206. *ff*

The Food before it can prove *Aliment*, muſt be comminuted, and broken into the ſmalleſt Particles, which in theſe membranous Stomachs, I cannot ſee how it can be performed, but by Corroſion. A principal Menſtruum in doing this, I take to be that Liquor, which is diſcharged by the Glands, that are ſeated ſome at the Beginning of the Throat, and are called *Salival*, or juſt above the Stomach or Gizzard of Birds, and called the *Echinus*; or in others, in the Stomach itſelf; and called the *Glandulous Coat*, and ſuch I take the *Inward Coat* of the Stomach of our *Rattle-ſnake* to be. When

Comminuted, 'tis diſcharged into the Guts, which, that the Chyle might not
Fig. 206. *ee.* paſs off with the *Fæces*, are often convoluted, or Winding, as here: That
ſo by impeding a too quick Deſcent of it this Way, or by Valves, a Separation
may the better be made; and then the *Fæces* as uſeleſs, cannot
quicker be diſcharged than by the *Rectum*; which where the *Fæces* are
hard, is furniſhed with a ſtronger Muſcle; the better to help its Action;
and ſuch ſeem'd the *Rectum* here, and the *Fæces* harder than uſual in Vipers.

Fig. 205. *k.* The Heart was placed near the bottom of the *Trachæa*, on the Right ſide
of it. The Length of it was one Inch and half, its Figure rather flat than
Fig. 205. *l.* round; encompaſſed with a *Pericardium*, and the Article larger than the Heart
itſelf. It hath but one *Ventricle*, the Valves ſmall and fleſhy, and the inſide
of the *Ventricle* diſtinguiſh'd by four or five croſs Furrows. Why *Charas* ſhould
make the Heart of the *Viper* to have two Ventricles, I ſee no reaſon: I ſhould
Fig. 205. *nnn* much more eaſily allow a double Auricle, one at the Entrance of the *Vena*
Cava, of which there are two Branches deſcending, and one aſcending; the
Fig. 205. *mmm.* other for the *Arteria Aorta*, which has two aſcending, and one deſcending.

Fig. 255. *oo.* A little below the Heart lies the Liver, which was about an Inch wide, in
the largeſt Place; and ſeem'd divided on one ſide by the *Vena Cava* into
two Lobes of an unequal length; for that on the left Side was about ten Inches,
and that on the right Side about a Foot long. Its Colour was a brown
Fig. 205. *p.* red, and its uſe, no doubt, for the ſeparating the Gall that was contained
in a Bladder ſeated at ſome Diſtance below it. This *Gall-Bladder* was
two Inches long, the Colour of the Gall contained in it a Graſs-green, which
ſweating through its Coats, had deeply tinged all the adjacent Parts; the
Taſte of it, in a *Viper*, which ſeems the ſame (for I did not taſte it here) was
firſt ſalt, then a ſweet-bitter. The *Ductus* which brings it from the Liver,
is obſcure, and hard to be found: But the *Ductus Cyſticus*, by which it empties
itſelf into the Inteſtine, is evident enough. It ariſes from the top of
Fig. 205. *d.* the Bladder; ſo gently deſcending, paſſes thro' that part which *Charas* takes
for the *Pancreas*, by which the Ancients call'd the *Spleen*, and ſo enters the
beginning of the larger Inteſtine. In *Vipers* indeed, the Colour of this Part,
and Situation ſo near the *Inteſtine* ſeems an Argument for *Charas* his Conjecture;
but here its Colour, which was deep red, and ſuch hitherto I have
obſerved the *Pancreas* to be in no other Animal, as likewiſe its Figure, not
ſpreading, but more compact, ſeem to favour the Opinion of the Ancients.
I have only this to ſay of it, that it was about the bigneſs of a large Bean;
that it adhered to the Side of the Inteſtine at the beginning of it, and
that through the middle of it, as is already obſerved, the *Ductus Bilarius* did
paſs.

The Fat, which was very plentiful, is ſaid to be uſed by the Phyſicians of *Mexico* with good Succeſs in the *Sciatica*, and all Pains of the Limbs, and for diſcuſſing Preternatural Tumours. The Membrane it adhered to I take for the *Omentum*, which encompaſſed all Parts contained in this lower Belly;

and was joined to both ſides of the Ribs, ſo running to the *Rectum*, and forming a Bag that inveloped the Parts here, but was free and not conjoined towards the Belly. The lower Belly I call it, to diſtinguiſh it from the reſt of the Trunk, for the whole was but one continued *Cavity*, there being no Partition of it by any *Diaphragm*.

The two Kidneys which lay to the Back on each ſide of the *Spine*, but not *Fig.*206. very firmly conjoined, were about ſeven Inches long, that on the right ſide ſomething longer than the left, and about half an Inch broad each: And though the Subſtance of it ſeems one continued Body, yet it is plainly diſtinguiſhable into ſeveral leſſer Kidneys; for they ought to be reckoned as many as there are diſtinct Syſtems and Orders of Veſſels, which according to the Advantage of the Body of this Animal, are placed at length, not piled on one another. As I remember, in one of the Kidneys I numbred twenty-five, all very curiouſly contrived, and with an inexpreſſible Beauty. When they were firſt taken out of the Body, the whole ſeemed a delicate *Compages* of Veſſels, and the Intermixture of thoſe of the Blood, with thoſe other white ones, that are the *Secretory*, compoſed moſt regularly-formed Bodies. In the Figure, that on the left ſide repreſents the upper Superficies of the Kidney, which appears firſt in the *Diſſection*; the other, the lower ſide which lies to the Back; in both there are two large Blood-Veſſels running down each ſide, one marked *n n n*, the other, where the *Vas deferens* runs, but is not here repreſented, and from theſe ariſe ſeveral leſſer Branches, *o o o* at ſet Branches, which curiouſly ſpreading themſelves do form, as it were, *Ramifications* of Trees. As many as there were of theſe emulgent Veſſels (for ſo I take them to be) ſo many Kidneys were in each; the Interſtices *p p p* of theſe Blood-Veſſels, were filled up with other white ones, which I doubt not are for the Secretion of the *Urine*, and on this ſide did appear more numerous than on the other. But 'tis impoſſible to repreſent the curious Interweavings of both; but here in the under-ſide of the right Kidney, in ſome places they appeared more diſtinct; for *Q Q* ſhews the large Blood-Veſſel, whence ariſe the *Emulgents*, *r r r*, which ſpreading themſelves very thick into the Bodies *s s s*, make them appear all bloody; between which for a little Space, there appears a ſmall Body of the *white Secretory Veſſels*, *t t t*. The Uſe of this Part, in all Animals, is for carrying off the *Lixivial* and ſuperfluous *Serum* of the Blood, which is of ſo great Conſequence, that even thoſe Animals that drink not at all, or but very little, yet by Nature are furniſhed with them; as the *Rattle-Snake* may be thought. When the Separation of this Humour is made in the Kidneys, 'tis conveyed thence by the *Ureters* into a Bladder, if the too frequent Excluſion of it might be inconvenient to the Animal; or, if it be made in leſſer Quantity, into a *Cloaca*, juſt at the *Anus*, and ſo to be ejected.

The *Ureters* did run almoſt the Length of the Kidneys, being a com- *Fig.*208 *a a.* mon Trunk that received the leſſer Branches, that went to each ſingle Gland, and did terminate near each other in the *Cloaca*, making a Riſing there; for our *Rattle-Snake*, like Birds, had a *Cloaca*, which in the Female *Viper*, receives the Orifices of the *Ureters*, and the two *Uteri*, and in part may be ſaid that of the *Rectum* too, which had a *Connivent Valve* that covered it.

Fig. 200. *mm* Near the Verge of the *Cloaca*, we obſerved two other Orifices, which ſeemed covered by the folding of the Skin, and theſe led into thoſe two Bags which I have taken the Liberty to call the *Scent-Bags:* One of them was about an Inch long, and as big as a Gooſe-Quill, but taper towards the End, and from the Colour of the Liquor it contained, appeared darkiſh: The other Bag was ſomething leſs, and its Colour as in the *Viper*; this Difference, I ſuppoſe, may be accidental. The Liquor included in them was ſomething craſs, and of a ſtrong and very unpleaſant Smell; ſuch, but in a more intenſe Degree, as the Animal did emit before Diſſection.

I ſhall here add, that our *common Snake* emits a far greater *Fætor* (which lies in the ſame Bags) than our *Adders* or *Vipers:* And I have been told by Travellers, that ſome *Crocodiles* will leave a ſtrong but grateful Smell behind them; which, if ſo, I doubt not but it may be upon the ſame Cauſe.

But uſually, tho' this Liquor when new, and in great quantity, be offenſive and of an ill Smell, (and ſuch is *Civet* likewiſe, which is nothing elſe) yet when dry, and in leſſer proportions, it may prove more grateful.

Thus the Liquor in the Scent-Bags of a *Weaſel* being dried on a Paper, and kept ſome time, did not ſeem unpleaſant to me; but rather the contrary: And I ſee no reaſon why *Pole-Cats* may not be *Civet-Cats*, though they may not turn to that Account. But in a *Lion* I diſſected, the Liquor contained in the Scent-Bags was in the Opinion of all that ſmelt it, much like that of Oil of *Aniſe*, or *Fennel-Seed*; which was almoſt the only Difference I could find between the *Lion* and a *Cat*; for in a *Cat* this Liquor is ill ſcented.

Fig. 206. *bb* The *Teſtes* are very unproportionate in length, the Right being two Inches and a quarter long, the Left one Inch and a quarter long, ſcarce ſo big in Compaſs as a Gooſe-Quill. The unequal length of this Part *Charas* takes notice of in *Vipers*; and I ſhall add, that the *Ovarium* of the *Female Viper* is the ſame; for that of one ſide was as big again as the other. The Colour of the *Teſtes* was White, as is uſual, and ſo was their Subſtance. The *Vaſa Præparantia*
Fig. 206. *ii* had nothing uncommon: But the *Deferentia* were remarkable; for though they did run in a ſtreight Line almoſt from the *Teſtes* to the *Penis*, and did form no large Body, yet this *Ductus* was ſo often involuted, that were it unravelled and extended its whole length, 'twould be twice as long; which made me think that it was only the Extenſion of the *Epididymis*; for the whole *Teſtes* is but a *Congeries* of curiouſly convoluted Veſſels which terminate in the *Epidydimis*, whoſe Continuation makes the *Deferens*. And where its *Convolutions* are many upon the Body of the *Teſtes* itſelf, there the *Deferens* is an even *Ductus:* But as in our Subject it making no ſuch Body

there, or but a very ſmall one, in its Paſſage downwards it was every where crimpled, and about the middle of the Kidneys often convoluted. Upon the Diſſection of a *Viper*, I have ſince found that they were continued along the *Penis*, ſingle where the *Penis* was ſo, and afterwards divided, and did run to the end of each: Nor were there any *Veſiculæ Seminales* or *Proſtates* here to receive them.

Fig. 207. *a*

*Fig.*206. *kk*

There were four *Penes*, two on each ſide, which lay ſheathed in the Body: So that upon firſt opening it they were not perceived, but only the large *Orifices*; where they were drawn in as a Finger of a Glove may be by a Thread faſtned to the end. But having protruded them by a *Probe*, they appeared as is repreſented in the Figure. And I did obſerve, that towards the *Baſis*, or Root, they were ſingle of each ſide, and that here they were thick beſet with Prickles, whoſe Points looked backwards, and were very ſharp and ſeem'd, eſpecially when dry, like the Subſtance of the Briſtles of a *Hedge-Hog*; but hence they were divided, and did form two round Bodies of the bigneſs of a ſmall Gooſe-Quill, about three quarters of an Inch long, of a red Colour, but the whole, as protruded, was above an Inch long. When protruded, I found they could be eaſily retracted, and drawn in by the help of large Muſcles that were faſtened to them, and did run along under, and were at laſt inſerted at the end of the Tail, at the ſetting on of the firſt *Rattle*; which upon the Trial was ſo plain, that we need not doubt of the uſe of them, and I ſhall therefore call them *Retractores Penum*. There are ſeveral Animals that have no *Penis* at all, but *Vaſa Deferentia*, as moſt Fiſhes. All *Quadrupeds* that I know of have but a ſingle one. Some Birds have but one. Moſt others, if they may be ſaid to have any, have two, but very ſhort. In *Crabs*, *Lobſters*, &c. there are two long ones, one on each ſide; but *Earth-worms*, *Leeches*, *Shell-ſnails*, &c. are *Hermaphrodites*, and have the perfect Organs of both Sexes. But where the Sex is ſingle, the *Rattle-Snake* and that Family have theſe Organs of Generation the moſt numerous of any I have hitherto met with. But why the Male *Rattle-Snake*, or the Male *Viper*, ſhould have four *Penes*, when the Female has but two *Uteri* for receiving them, ſeems a Difficulty to me. Amongſt many Conjectures I have had about it, what ſeems the moſt to ſatisfy me, is this; That they have the *Penis* here on each ſide double, or forked, that ſo being entered the *Uteri*, by ſpreading themſelves like the *Pythagorean* Y, they may the better and more firmly be retained there till they have performed their Duty. And this too ſeems one uſe of the *Aculei* or Briſtles, towards the Root of them; for having their Points looking backwards when once they have entred the *Pudendum*, they muſt needs lock them in, and retain them there, till ſuch times as the parts being tired and ſubſiding, have leave to retreat. For in Animals they have no *Veſiculæ Seminales*, 'tis requiſite that the *Coitus* be long, that ſo the Seed which cannot quickly, may leiſurely be tranſmitted from the *Teſtes*; but where 'tis beforehand ſtored up in the *Veſiculæ*, there the *Coitus* is ſoon over; but when they muſt expect the Generation, or at leaſt a ſluggiſh Deſcent of it, Nature makes Proviſion for the more convenient performing it. So in Dogs, which have no

that

Veſiculæ Seminales, near the Root of the *bony Penis* there is a large Body made up of an abundance of Cells and Veſſels; which, upon the ruſhing in of the Blood and Spirits, is ſo mightily extended and ſwelled, that it forcibly keeps him in, till ſuch time as the *Impetus* be over, and the part ſubſides. So the *Lump-fiſh* on it's Breaſt has a large round Body curiouſly contrived, like the Tail of a *Leech*, or the *Acetabulum* of the *Polypus*, by which it can firmly adhere to the Female, and ſo by this means, tho' its *Penis* be very ſhort, yet be able to perform a *Coitus*. *Cats*, *Lions*, &c. which have likewiſe very ſhort *Penes*, that they may the better cling, are forced to make uſe of their Teeth and Claws; and from the Pain of theſe, not from the ſcalding of the Seed, come thoſe fierce Shrieks and hideous Yowlings. Therefore in our *Rattle-Snake*, (where, as we have obſerved, there are no *Veſiculæ*, and where the *Vas Deferens* is all along crimpled and winding: and ſo upon both Accounts muſt be thought to be long in Coition) the Contrivance and Structure of theſe Parts ſeem very requiſite. For although in this Action they twiſt their Body, which may be ſome Advantage too, yet not ſufficient alone; for otherwiſe upon a little Occaſion the Parts would be apt to ſlip out, which now they cannot, being Forked and Hooked in too by the *Aculei* or Briſtles. But the *Deferentia* being continued to the end of the *Penis*, do likewiſe ſhew this muſt be the uſe of them. But that the Female may receive no Injury by theſe *Spines*, Nature has made that Part of the *Uteri* which they enter, ſtrong and griſtly; as we obſerved in a *Viper*; and that the Male too might not be harmed by an over-Extention of theſe Parts, thoſe ſtrong Muſcles, which ſerve for Retracting and drawing them in, do likewiſe ſecure them in this reſpect too. It may be likewiſe conſidered, ſince they are naturally ſo cold and *Frigid*, whether theſe *Aculei* may not ſerve to incite them, and ſtir them up.

Fig. 209. *g.* The Head was but ſmall, yet the *Rectus* was very large. The Tongue in all reſpects like that of a *Viper*, was compoſed of two long round Bodies, contiguous and joined together from the Root two thirds of its length, with great Agility they could dart them out, and retract them again; and that part which appeared out was of a black Colour, whereas that which lay ſheathed within was red; for 'twas faſtened below the Throat, and thence was covered with a *Vagina* or Sheath to the place where it iſſues out, which was near to the end of the *Larynx*; and for the better Ejaculation of it, the under Jaw too was here divided, leaving a conſiderable ſpace.

Fig. 209. *i.* For if it were conjoined as in other Animals, and beſet with Teeth, they would be apt to injure the Tongue; or at leaſt, it might prove incommodious to the uſe 'tis deſigned for, which in part I ſuſpect with *Charas* to be for catching Flies, and ſuch ſmall Creatures they have a mind to devour.

Fig. 209. *f.* Over the Tongue did lie the *Larynx*; not formed with that Variety of *Cartilages* as is uſual in other Animals, but ſo as not to make a Ruin or Slit, for Receiving or Conveying out the Air. Nor was there any *Epiglottis* for preventing other Bodies from ſlipping in; this being ſufficiently provided for, by the ſtrict Cloſure of them: And the Air paſſing only through ſuch a ſlit, without the Contrivance of other Parts for modulating it, can only make ſuch a Sound as we obſerve in their Hiſſing.

The Teeth are of two ſorts. 1. The leſſer which are ſeated in each Fig.209. cab
Jaw, and ſerve for the Catching and Retaining the Food. 2. The Poi- Fig.209. dd Fig. 210. b.
ſonous Fangs which kill it, and are placed without the upper Jaw. They Fig. 211. b.
are all *Canini* or *Apprehenſores*: For ſince they do not chew or bruiſe their
Food, but ſwallow all whole as they meet with it, there is no need of *Mo-*
lares. Of the firſt ſort of Teeth, in the lower Jaw there are two Rows on Fig. 210. g.
each ſide; five in a Row, the inward leſſer than the outward, ſo that Fig. 210. f.
there are here twenty in all. In the upper Jaw are but ſixteen, five on each ſide placed backwards, and ſix before; theſe do no harm. The Fangs are placed without the upper Jaws, towards the fore part of the Mouth, not faſtened to the *Maxilla*, as the other Teeth; but the two outmoſt and largeſt Fangs were fixt to that Bone, which, if any, may be thought to be the Ear-bone. The other Fangs I could not perceive were faſtened to any Bone, but to *Muſcles* or *Tendons* there. Theſe Fangs, or larger Teeth, were not to be perceived upon firſt opening the Mouth, they lying couched under a ſtrong Membrane or Sheath; but ſo as did make a large Riſing there on the outſide of the leſſer Teeth of the *Maxilla*, but at pleaſure when alive they could raiſe them to do Execution with; not unlike as a Lion or a Cat does its Claw. Theſe Teeth were hooked and bent like the Teeth of a *Barbaroſſa*; but ſome of the ſmaller of them were bent at Right-Angles. On each ſide we met with about ſix or ſeven, but not placed altogether ſo exactly as in the Scheme. In all theſe Teeth, eſpecially the larger, we took notice of a pretty large *Foramen*, or Hole towards the Root of it, and towards the Point there was a plain viſible and large Slit, like the cut of a Pen ſloping; and that part from the Slit to the Root was perfectly hollow; which firſt of all was diſcovered to us, by preſſing gently with our Finger the ſide of the Gum; for then we did perceive that the Poiſon did readily ariſe through the hollow of the Teeth, and iſſued out of the Slit.

This Poiſonous Liquor I obſerved to be of a Water-colour lightly tinged Yellow. What the Poiſon of *Serpents* is, and how it produces its dire Effects, has been of late conteſted between S. *Redi* and M. *Charas*: 'Tis *Redi*'s Opinion, that the yellow Liquor contained in the *Veſicles* of the Gums of *Vipers*, is the only and true Seat of the Poiſon; that this Juice is not Venomous, when taken in at the Mouth; but that it is ſo when let into Wounds, whether it be uſed when liquid, or after it is dried. But M. *Charas* wholly oppoſes this, and aſſerts, that the Poiſon is no where but in her inraged Spirits; and that this yellow Juice is nothing but a meer innocent *Saliva*.

But the Fabrick of the Teeth, (they being thus Hollow, and having that large ſlit towards the end, and this Juice ſo readily and naturally iſſuing through them) ſeems to me to argue, that Nature deſigns it for other Uſes than Nouriſhment; for if ſo, by giving them ſo large a Vent ſhe would be fruſtrated of her end. But they being ſo ſharp and ſtrong at the Ends, and the Slit too placed towards the back, not inſide of the Tooth; what can be more conveniently contrived both for making the Wound and infunding the Poiſon? For if the Slit was inwards, by the ſtruggling and withdrawing of the Animal aſſaulted, the Slit would be apt to be ſtopt and occluded; and the deſcent of the Poiſon prevented: But being thus formed, it gives a greater Advantage for its Infuſion. Thus the *Scorpion*, the *Bee*, the *Emmet*, nay, the Sting of a Nettle, at the ſame time they make a Wound, they leave behind them a drop of Liquor, which excites thoſe dreadful *Symptoms*: Whereas the Wound without it, would be inconſiderable. And what has ſome Weight with me (contrary to the Sentiments of M. *Charas* of the Innocence of this Liquor) is a Relation I had from an intelligent and knowing Perſon, who informed me that being in the *Indies*, there came to him and his Company an *Indian* with ſeveral ſorts of Serpents, and offered to ſhew them ſome Experiments about the force of their Poiſon, and the difference of them; and that this Practice is common with them. Having therefore pulled out a large one, the *Indian* told him that this would do no harm; therefore making a *Ligature* on his Arm, as they do in Letting Blood, he expoſed it naked to the Serpent, having firſt whipt and irritated him to make him bite it. The Blood that came out of the Wounds, made by his Teeth, he gathered with his Finger, and laid it on his naked Thigh till he had got near a Spoonful. After this he takes out another called *Cobras de Cabelo*, which was leſſer, and inlarges much upon the greatneſs of its Poiſon; and to ſhew them in part an Inſtance of it, graſping it about the Neck, he expreſſes out ſome of the Liquor in the Bags of the Gums about the quantity, as he thought of half a Grain, and this he puts to the Coagulated Blood on his Thigh; which as ſoon as mixt with it, ſtreight put into a great Fermentation, and Working like *Barm*, changed it into a Yellowiſh Liquor. The ſame has been likewiſe obſerved by others, and does ſeem to give us ſome Light, how 'tis that this Poiſon acts, and confirms the known Obſervation, that the biting of a *Viper* will cauſe the *Yellow Jaundice*. A preſent Antidote for this Poiſon is ſaid to be the Snake-Stone; *Pierre de Cobras de Cabelo*, 'tis called by the *Portugueſe*, and is famous all over the *Indies*; 'tis deſcribed by *Garcias ab Horto*, by *Kircher* and others, particularly by Senior *Redi* who renders very much ſuſpected the Relations that are commonly had of its great Force and Virtue: But that it does not always fail, ſome Accounts I have had of Perſons relieved by it here in *England* have convinc'd me. One inſtance is remarkable that was told me by an Eminent Phyſician in *London*, of a Perſon near the Town that was bit by a *Viper*; his Hand and Arm ſoon ſwelled with great Extremity of Pain: But upon the Application of this Stone for one Night both were aſſwaged, and he thought himſelf well, and took off the Stone, which did ſtill firmly adhere. But not long after his former Symptoms violently returning, he had recourſe to his Antidote, and then ſuffered it to continue there till it fell off it ſelf,

Vide infra XLVIII.

and ſo was cured. One Trial I formerly made my ſelf, in a Patient troubled with the Gout in her Stomach; having removed it thence, it ſeiz'd her Toe; but ſhe being impatient of the Pain, that I might ſeem to do ſomething, and to hinder her uſing abundance of Medicines, which every Body was like to adviſe her to, and might be apt to ſtrike it to her Stomach again, I thought of this; holding the Stone therefore in my Hand, and without acquainting her, I put it near the Joint where her Pain was moſt; and being very near it, I perceived it move out of my Hand, and readily adhere to the Part. Soon after ſhe acquainted me, that ſhe very ſenſibly perceived a great drawing and trickling all down her Leg and Thigh, and afterwards owned an Abatement of her Pain. In Peſtilential Swellings very probably it may be of uſe.

Amongſt the Bones of the Head, I obſerved that the *Cranium* here was *Fig. 210. a.*
entire, and without Sutures: Only where ſome other Bones were joined to them; as forwards over the Noſtrils were two ſmall Bones, to which were faſtened the *Cartilages* or rather Bones, which divided the Noſe. The other *Fig. 210. cc d*
Bones ſeemed admirably contrived for the great Extenſion, and widening of the *Maxillæ*: Which ſeems a great Proviſion of Nature; for ſince it muſt ſwallow all things whole, and its Head is but ſmall, without this moſt Mechanical Contrivance it were impoſſible to do it. The upper Jaw forward was joined to the Bone that receives the Poiſonous Fangs; and which had a large Cavity in it, which opened outward, and was thought to be the *Foramen* *Fig. 209. b.*
of the *Ear*; but inwards we obſerved no Perforation for a *Nerve*, unleſs there might be one that comes to it under that Bone which conjoins *Fig. 210. ee.*
it to the *Cranium*. This Articulation ſeems advantageous, both for the Motion of the Fangs, which lie ſometimes couched, ſometimes erected, as of the Jaw too: But its principal and moſt remarkable Advantage for ſwallowing large Bodies, is the curious Articulation of the *Maxillæ* backwards to the *Cranium* by two Bones, which from their uſe (ſince we know no Name to diſtinguiſh them by) we ſhall call *Maxillarum Dilatores*. Their ſhape, *Fig. 210. n c*
bigneſs and aptneſs for this Motion will readily enough be conceived by the Eye in obſerving the Figure. For the lower Jaw being not conjoined at the *Mentum*, as is uſual in other Animals, but parted at a good Diſtance; upon the receiving a large Body, as the Membrane here to which they are faſtened eaſily extends, ſo by lifting up, as alſo by bringing theſe two Bones more to a ſtraight Line, it muſt needs conſiderably widen the *Rictus* of the Mouth: and for this Cauſe too they are made two, not one, for performing this Motion more eaſily. This *Articulation* of the *Dilatores*, which is very curious, with the upper and lower Jaw, makes thoſe Protuberances of the Head, which we likened to that of a Bearded Arrow. The lower Jaw of *Fig. 210. m.*
each ſide was compoſed of two Bones, as appears in the Figure, but firmly conjoined. The Fore Bone was for receiving the ſmall Teeth, the hinder *Fig. 210. k i*
towards the Articulation grew broad; as likewiſe did the Bone of the upper Jaw anſwerable to this piece in the lower. But this upper Jaw, towards the *Fig. 220. i i*
Poiſonous Fang, divided into two Bones; one was faſtened to the Bone of the

Poiſonous Fang outwards ; the other, which received the ſmall Teeth, was inſerted into ſome Bone more inwards.

The *Vertebræ*, according to the whole Figure of the Body, were ſmalleſt towards both Extreams, and largeſt in the middle. From the Neck to the *Anus*, there were as many obſerved as Scales on the Belly, *viz.* 168. but from the *Anus* to the ſetting on of the Rattle, twenty-nine more in Number than the Scales.

*Fig.*212. *ab.* *Fig.*212.*c.d.* *Fig.* 212. *e.* *Fig.*213. *bb.*

The former *Vertebræ* had a flat upright Spine towards the Back ; and a ſlender round Oblique deſcending one inwards to the Belly. To each *Vertebræ*, beſides thoſe Spines juſt mentioned, there were other *Proceſſus*'s for the advantage of ſetting on of the Ribs, and the Articulation with one another : But what was moſt remarkable, was the round Ball in the lower part of the upper *Vertebræ*, which enters a Socket of the upper part of the lower *Vertebræ* like as the *Head* of the *Os Femoris* does the *Acetabulum* of the *Os Iſchii* ; by which Contrivance, as alſo the Articulation with one another, they have that free Motion of Winding their Bodies any ways. The Ribs in the Neck were ſmall, but larger towards the middle of the Body, where they were about two Inches long ; but towards the Tail they grew leſſer and ſhorter again ; and did all terminate at the beginning of the Scales of the Belly. In the *Vertebræ* of the Tail inwards there were two Spines : Whereas in the other *Vertebræ* there was but one ; as likewiſe there were here Tranſverſe ſlender *Proceſſus*'s ſomething Analogous to Ribs.

Fig. 11, 12. *Muſ.* R. S. *p.* 51.

To the laſt *Vertebræ* of the Tail was faſtened the Rattle ; in our Subject there was but five, but ſome others ſeemed to be broken off. That next the Tail was of a Lead-Colour ; the others, of a Cinericious. 'Tis well deſcribed by Dr. *Grew*, in his *Muſæum Reg. Soc.* This Rattle, according to *Gulielm. Piſo* (and I know no other uſe of it) was given by Nature to this Pernicious Animal, *ut illius* Sonitu *admonitus quilibet Homo non ſolum, ſed & qualecunque pecus, vel jumentum, tempeſtive ſibi caveat à vicino Hoſte.* Some Authors aſſert, that every Year there is an Addition of a new Rattle ; which Dr. *Grew* ſuſpects, for then he muſt live ſixteen Years ; for ſo many Joints there are obſerved in ſome in our Repoſitory ; I have been told, in ſome there have been above twenty. Theſe are placed with their broadeſt part Perpendicular to the Body, not *Horizontal.* And the Firſt is faſtened to the laſt *Vertebræ* of the Tail by means of a thick *Muſcle* under it ; and by the Membranes that conjoin it to the Skin.

Explication of the Figures, deſigned by Mr. Rich. Walter, *ib. p.* 55.

Fig. 205. Repreſents the upper part of the Body opened. *a a a.* The *Aſpera Arteria.* *B.* The upper part of the Lungs, which is *Veſiculous.* *c c c c c.* The lower part of the Lungs, which makes a large Bladder. *d.* The Firſt Swelling of the *Oeſophagus*, or Falſe Stomach. *e e e.* The *Oeſophagus*, or Gullet, and that part of it where 'tis Streighter. *f.* The Second Swelling of the *Oeſophagus*, or *Second Falſe Stomach.* *g.* The *True Stomach.* *h.* A ſhort ſtreightning of the *Gut*, a little below the *Pylorus.* *i.* The *Inteſtines.* *k.* The *Heart.* *l.* The *Auricle.* *m m m.* *Three Arteries*, whereof there are two Aſcending, and one Deſcending. *n n n.* Three large Veins, whereof two are Deſcending, and the third

Aſcending ; which laſt does ſeem to divide the Liver into two Lobes. *o o.* the *Liver.* *p.* the *Gall-Bladder.* *q.* the *Spleen*, as 'tis call'd by the Antients ; but by *Charas*, the *Pancreas.* *r r r.* a large Blood-Veſſel that runs in the midſt of the Scales of the Belly. *s s.* the *Muſcles* belonging to the Scales of the Belly.

Fig. 206. The Parts contained in the lower part of the Body. *a a a.* The *Inteſtines* ; *b.* the *Gall-Bladder* ; *c.* the *Ductus Bilarius*, that paſſes through the middle of the *Spleen*, or as called by *Charas*, the *Pancreas*, and enters the large Gut ; *d.* the *Spleen*, or *Pancreas* ; *e e.* the *Inteſtines*, which were very large and winding, but ſhort ; *f f.* the *Rectum* ; *g.* the *Anus* *h h.* the *Teſtes* ; *i i i i.* the *Vaſa Deferentia* ; *k k.* the *Penes* on each ſide, which firſt at the Root are conjoined, and are thick beſet with Briſtles ; *l l.* the Muſcles that ſerve for drawing in the *Penes* ; *m m.* the Scent-Baggs ; *n n.* a large Blood-Veſſel that runs on one ſide of the Left-Kidney ; *o o.* the Emulgents that ariſe from the ſame ; *p p p.* the *Secretory Veſſels* ; *Q Q.* the large Blood-Veſſels of the Right Kidney ; *r r r.* the *Emulgents* ariſing from it ; *s s s.* a round Body of Blood-Veſſels ; *t t t.* Secretory Veſſels ; *u u.* the Ureters.

Fig. 207. The *Penes* of one ſide of a Viper. *a.* the *Vas Deferens*, which afterwards divides, and runs to the End of the *Penes* ; *b.* the *Penes* ; *c.* the Muſcle which retracts the *Penes* in.

Fig. 208. The Lungs open'd by the *Trachea.* *a a a a.* the *Arteria Aſpera*, divided in the middle ; *b b b.* ſome larger Branches of Blood-Veſſels ; *c c c.* the *Veſiculæ*, or Cells, of the Lungs.

Fig. 209. The Head, with its Mouth open'd. *a.* The Hole of the Noſtril ; *b.* the *Foramen* which leads to a large Cavity, which has no Perforation for any Nerve inwards : But 'tis thought to be for Hearing ; *c c.* the ſmall Teeth in the upper Jaw ; *d d.* the large Fangs, or Poiſonous Teeth ; *e e e.* the Place where the Bladders of Poiſon lie ; *f.* *Larynx* ; *g.* the *Forked Tongue* ; *h.* the Teeth in the lower Jaw ; *i.* the place where the lower Jaw is divided at the *Mentum.*

Fig. 210. The *Scull.* *a.* The *Cranium*, without any Sutures ; *b b.* the Orbits of the Eyes ; *c c.* two ſmall Bones over the Noſe ; *d.* the Griſtly or rather Bony *Sepimentum* of the Noſe ; *e e.* a ſmall Bone, that lies between the *Cranium* and that Bone in which is fixed the Poiſonous Fang ; *f f.* a Cavity in that Bone, to which is faſtened the Poiſonous Fang, whoſe outward Orifice is repreſented in Fig. 209. by the Letter *b.* and is thought to be the Ear ; *g.* the large Poiſonous Fang, which is faſtened to the Ear-Bone ; *h.* the other Poiſonous Teeth, which are not fixt in the Bone, but to Muſcles ; *i i.* the upper *Maxilla*, which contains the ſmall Teeth ; *k k.* one ſide of the lower *Maxilla*, with its double Row of Teeth, which in the middle ſeems to be joined by a Suture ; *l.* the diſtance at the *Mentum*, between the two ſides of the lower *Maxilla*, or Jaw ; *m m.* where the two *Maxillæ* are joined together backwards, and by a Tendon are faſtened to another Bone, which from its uſe, and for Diſtinction's ſake, we call *Dilatores Maxillarum* ; *n n.* the *Dilatores* of the Jaws ; *o o.* a ſhort Bone which joins the *Dilators* to the Scull, or *Cranium* ; *p.* the *Vertebræ* of the Neck.

Fig. 211. The Poiſonous Teeth.

Fig. 212. One of the *Vertebræ* of the Back. *e.* The outward Spine, of the *Vertebræ*, which is flat long ways; *b.* the inward Spine of the *Vertebræ*, which is round; *c.* a large flat *Proceſſus*, for the Articulation of the *Vertebræ*; *d.* ſmall Tranſverſe *Proceſſus's* for the ſetting on the Ribs; *e.* a round Ball, like the Head of the *Os Femoris*, which enters a Socket of the lower *Vertebræ*, as that does the *Acetabulum* of the *Os Iſchii*.

Fig. 213. One of the *Vertebræ* of the Tail. *a.* The Spine towards the Back; *b b.* the two inward Spines; *c c.* the Tranſverſe Spines Analogous to Ribs.

Fig. 214. The *Vertebræ* of the Tail, and the Muſculous Fleſh which faſtens the Firſt Rattle. *a.* The *Vertebræ*; *b.* the Muſcle on which is faſtened the Rattle.

Fig. 215. A Single Rattle, which has three Joints: The firſt and largeſt appears when Conjoined with others, the two other ſerve for the faſtening on the ſucceeding Rattles, and are covered by them.

Fig. 216. The Five Rattles as joined together.

A way of killing Rattle-Snakes; *By Capt.* Silas Taylor, *n.* 3. *p.* 43. *n.* 4. *p.* 76.

XLIV. The *Wild-Penny-Royal* or *Dittany* of *Virginia*, groweth ſtraight up about one Foot high, with the Leaves like *Penny-Royal*, with little Blue Tufts at the joining of the Branches to the Plant, the Colour of the Leaves being a Reddiſh-Green; but the Water Diſtill'd, of the Colour of Brandy of a Fair Yellow: The Leaves of it Bruiſed are very hot and biting upon the Tongue. Of theſe Leaves ſo Bruiſed we took ſome, and having tied them in the Cleft of a long Stick, we held them to the Noſe of the Rattle-Snake, who by turning and wriggling labour'd as much as ſhe could to avoid it: But ſhe was kill'd with it, in leſs than half an Hour's time; and, as was ſuppoſed, by the Scent thereof. This was done *A.* 1657, in *July*, at which Seaſon thoſe Creatures are reputed to be in the greateſt Vigour for their Poiſon. It is alſo remarkable that in thoſe Places where the *Wild-Penny-Royal* or *Dittany* grows, no Rattle-Snakes are obſerved to come.

The Breeding of Snakes *and* Vipers; *by*——, *n.* 8. *p.* 238.

XLV. There is this Difference between the Brooding of Snakes and Vipers; the Snakes lay their Eggs in Dunghils, by whoſe Warmth they are Hatched: but the Vipers Brood their Eggs within their Bellies, and bring forth Live Vipers. To which may be added, that ſome affirm to have ſeen Snakes lie upon their Eggs, as Hens ſit upon theirs.

Experiments made with Vipers; *By Mr.* Thomas Platt, *n.* 87. *p.* 5060.

XLVI. In order to examine the Opinions of M. *de la Chambre*, S. *Redi*, and others, concerning the Poiſon of Vipers, Dr. *Francini* came to the Houſe of S. *Magalotti* 2 *Jun.* 1672. and ſent for a Box in which were a great many Heads, cut off that Morning, of Vipers lately come from *Naples*. S. *Magalotti* alſo ſent to the Publick Market for a couple of Pigeons, to be ſure of having ſome that were not prevented by any Antidote. The Pigeons Being come, the firſt was wounded with the Teeth of a *Viper*'s Head that had been cut off about 7 or 8 a Clock the ſame Morning. The way of making the Wound, was by thruſting twice the Maſter-Teeth into the fleſhy part of the Pigeon's Breaſt, till ſuch time as preſſing the upper part of the Jaw, the two little Bladders, that ſerve as Gums to the Teeth, did empty out upon the Wound ſome of that Yellow Liquor which here is ſuppoſed to be the true and only Poiſon of the *Viper*. This Pigeon being thus Bit, and ſet upon the Ground, began to ſtagger immediately, and died in leſs than three or four Minutes. The ſecond Pigeon was wounded in the ſame manner; but at the firſt Wound there only entered one of the Teeth, which brought forth a great deal of Blood; the ſecond time they both entered, and this had the ſame Fate, with this difference only, that he languiſh'd half a quarter of an Hour.

The next Morning ſix Pigeons and a Cock having been brought, Dr. *Francini* at firſt, thruſt ſeveral Thorns of *Roſe-Shrubs* into the Breaſt of one of thoſe Pigeons, to manifeſt, that ſuch Accidents as might befal thoſe that ſhould be Wounded by the Teeth of the Dead *Viper* were not meerly cauſed by the Wound; and afterwards for the further ſatisfaction of the Company, he took a Pin, which was none of the leaſt, and gave another Pigeon a very deep Wound in the Breaſt, which was no ſooner got free, but began to leap and friſk about the Room, as if it had not been concerned in the leaſt. Then a third Pigeon was bit in the Breaſt by both the Maſter-Teeth of a *Viper's* Head, that had been cut off the Morning before; the Effect was, that the Pigeon had the ſame ſhaking Fits; after which, falling upon his Belly, in five or ſix Minutes after the Wound, he died; giving Signs a little before of a Painful Agony, by his often Gaping. Another having been ſerved after the ſame manner with another Head, had the like Accidents, and died within a quarter of an Hour. It was alſo obſerved that the Wound of this laſt Pigeon let out a great deal of Blood, whereas not ſo much as one Drop was ſeen to come out of any of the others.

After the Experiments the Doctor took three Stalks out of a Broom, and having ſmooth'd them, and ſharpened them at the ends after the manner of a Lancet, he drew from the Gums of ſeveral Heads enough of that Yellow Juice to dawb two of thoſe Stalks; which being thus moiſtened with that Liquor, were both put into the Breaſts of two Pigeons, and there left, the like having been done to another with the third Stalk not covered with that Juice, which was at leaſt one third part bigger, and no longer than the other two. In a word, the two firſt died within four or five Minutes, and the laſt was in *Auguſt* following in *S. Magalotti*'s Pigeon-Houſe, as briſk and fat as ever, tho' the Stalk was not drawn out till after ſome Days.

Upon a Relation, that ſome had aſſerted at *Paris*, that to ſwallow a Viper's Head, was a moſt certain Preſervative and Remedy againſt the biting of a *Viper*; Dr. *Francini* made theſe two Experiments. He made the Cock ſwallow a Viper's Head, and then cauſed him to be well bitten in both Thighs by a Live one. The other Experiment was by thruſting the Teeth of a Dead Viper's Head into another Pigeon, that had before got down one of theſe Heads into his Belly. The Concluſion was, that both died, the Cock within a quarter of an Hour, and the Pigeon in leſs than four Minutes.

Some few Days after, Dr. *Francini* repeated the ſame Experiments, by cauſing two Pigeons to be bit by a *Viper*'s Head that had been dead above ten Hours; they both died, one in ſix Minutes, and the other in eight. And with another *Viper*'s Head he Poiſoned a Chicken, which died in ten Minutes. There appeared afterwards another Pigeon, that had been Wounded, many Hours before, by a Dead *Viper*'s Head, but it had been Dead ſo long, that the Liquor quite dried up in the Gums was become ſo hard, that for all the ſqueezing of it nothing would come to the Teeth, whence this Pigeon was very well: And Dr. *Francini* having cauſed the ſame Bird to be bit again by the ſame dried Head, it had, after a little fluttering with his Wings, whilſt the Pain of the biting laſted, no other harm.

A live *Viper* being taken, four Chickens were bit by it one after another. The two firſt, either becauſe the Liquor did not penetrate into the Wound, or the Blood expell'd it, appeared not to have any Diſtemper; the fourth looked as if it would die preſently, but a little after, coming to himſelf, he got clear off for that time; but the third, who ſeemed at firſt to be very lively, died within an Hour and an half.

There being afterwards a young Bitch brought in, of a pretty ſize, ſhe was bit twice by a live *Viper* in the middle of the hanging part of the Ear. Whereupon ſhe very ſoon began to give Mortal Signs, by Staggering, Vomiting and being Convulſed; after which having a little recovered herſelf, the ſame Accidents returned upon her, by which ſhe was reduced to ſuch a grievous Condition, that four Hours after her being bit, ſhe could not ſtir any more, and ſeemed juſt as if ſhe had been Dead, holding out her Tongue and looking very ghaſtly, without any other ſign of Life than that of a painful Breathing; to which ſhe added ſometimes a faint Barking, and a languiſhing Howling. In this Condition ſhe was ſtill found the next Morning; only her Reſpiration was yet weaker, and ſhe appear'd juſt a drawing to her end. It was obſerv'd that no part of her Body was ſwelled, nor had any Spot upon it. She had voided backward ſome Matter of a very black Colour, of which her hind parts being very foul, a ſwarm of *Gnats* and *Waſps* were devouring her alive: Which moved one of the Servants of the Houſe to knock her on the Head.

After this, there were bit two Capons and a Pullet by a freſh *Viper* vexed on purpoſe; and becauſe they gave not then any Signs of being Ill, they were ſent back to their Coops, and there having continued well till Evening, they were ſurpriſed at Night by a Diſtemper, which in all likelihood proceeded from the Poiſon; for next Morning one of the Capons and Pullet were found Dead.

The Symptoms attending the Bite of a Serpent, By Mr. Azr. Goodyear. *n.* 245. *p.* 351.

XLVII. Mr. *Rob. Burdet*, an *Engliſh Merchant* at *Aleppo*, on the 4*th* of *Oct.* 1678, was bit by a *Serpent* on the left Wriſt, near the Pulſe towards his Hand. It ſeemed at firſt, like two pricks of a Pin; he immediately vomited, and his Wriſt and Hand began to ſwell preſently, he had ſome few Days before a Looſeneſs, which perhaps this increaſed. He rode eaſily, after he

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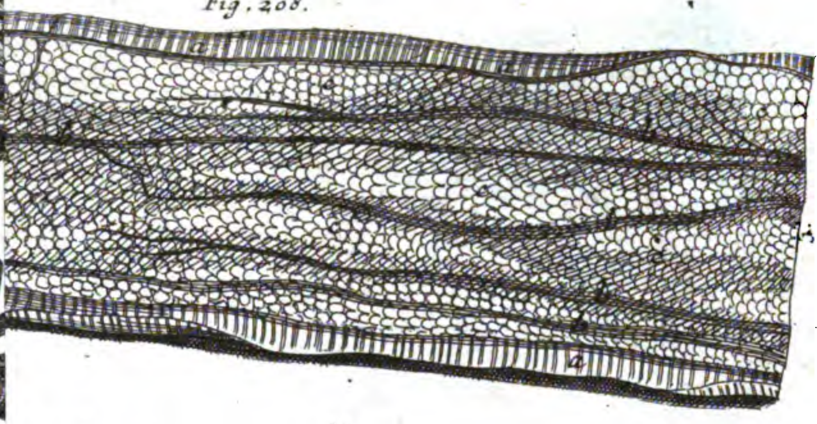


Fig. 208.

Fig. 196.

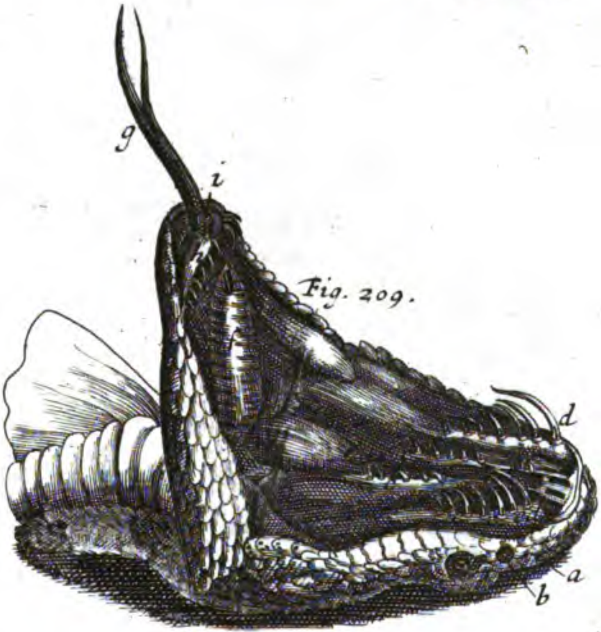


Fig. 209.

Fig. 211.

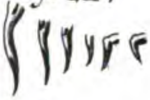
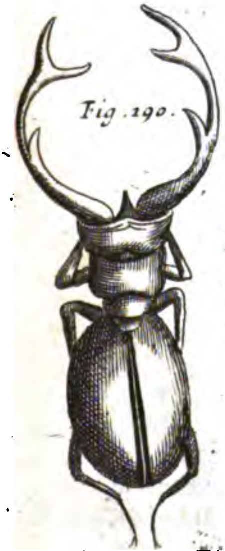


Fig. 190.



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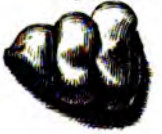

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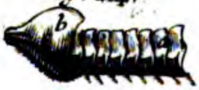

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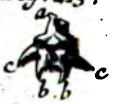

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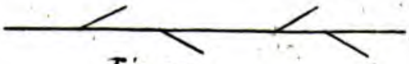

Fig. 203.

was bit, about two Miles from Home, and as ſoon as he got to his Chamber, he ſaid he was bit by a Rat, (and would not own it was a *Serpent*,) though a *Turk* accidentally paſſing by, ſaid, he ſaw the *Serpent* hang at his Wriſt, as he pull'd his Hand out of the Refuge, hoping to have taken a *Hare* that he had cours'd in there. He ſaid, he felt no Pain, but a great deſire to Sleep; his Arm continued ſwelling upwards, and grew black. Some little Remedies were uſed till the reſt of the Factory return'd, and then they begun to Cup and Scarify his Arm; he having ſtill no Pain, but a great Drowſineſs; but was kept Waking, to uſe that little time he had left, to prepare himſelf for Death; which he perform'd exceedingly well. At laſt the Swelling came up to his Shoulder, and then he complained much; and within a Quarter of an Hour died. He was bit about ten in the Forenoon, and died about three in the Afternoon. His Body ſwell'd much after Death, and Purged, the *Snake* was like a common *Snake* for length, his Colour dark-Sandy, with black Spots, his two Teeth or *Fangs* are like thoſe of a *Rattle-Snake* on the upper Jaw, the Poiſon lies in the Gums, and wherever they fetch Blood of any Creature they certainly kill, though in ſome parts ſooner than others. The People of the Country ſay, that if as ſoon as one is bit by a *Serpent* they ſhall ſuck immediately the Wound, they may be ſaved; but they muſt rub firſt their Gums and Teeth with Oil, that none of the Poiſon may touch any place where the Skin is broken, and ſpit out immediately what they ſuck; every time waſhing their Mouth, and taking more Oil. This *Serpent* kill'd a Dog, in about eight Minutes time, biting him at the end of his Ear; and two young Turkeys afterwards in three or four Minutes each, biting them at the end of a Claw; and then, we poiſoned him with the Oil of *Tobacco*, out of a *Reed-Pipe* (that had been much uſed, and not cleanſed for a Week or two) and he died in about two or three Minutes, trembling as ſoon as the Oil was dropt into his Mouth.

XLVIII. Sir *Philiberto Vernatti* ſome time ago ſent from *Java Major* (where he reſided) a certain Stone, affirmed by him, to be found in the Head of a *Snake*, which laid upon any Wound made by any Venomous Creature is ſaid to ſtick to it, and to draw away all Poiſon; and then being put in Milk, to void its Poiſon therein, to make the Milk turn blue; in which manner it muſt be uſed, till the Wound be cleanſed. The like Account of ſuch a Stone is given by Mr. *Thevenot*, in the Relations of his Voyages and Travels.

A Stone Healing the biting of a Serpent; By Sir Phi. Vernatti, *n.* 6. *p.* 102.

XLIX. The Venom of a *Viper*, in it ſelf is not mortal to a robuſt and ſound Body; and tho' very unhappy and miſchievous Accidents attend it, as a great Tumour, Tenſion, and Weight of the Part, Humidity and Variety of Colour, Phrenſies, Convulſions, and Vomitings; yet in eight or ten Days at moſt theſe Accidents are over; and although the Patient may be very Ill, yet he recovers again; whilſt the Poiſon, having run through divers Parts of the Body, at laſt throws it ſelf into the *Scrotum*, or Swelling; it extreamly cauſes a great Heat and quantity of Urine, very hot and ſharp, by which it is diſcharged; this *Evacuation* being the ordinary and moſt certain *Criſis* of the Diſeaſe.

Obſervations on ſeveral Poiſons, by Sir Theo. de Mayerne, *n.*211. *p.*60.

It is obſervable, that the Perſpiration being obſtructed by the Poiſon, a Man bit by a *Viper*, and ſwelled up, in three or four Days ſhall weigh almoſt as much more than he did before. A Sickly Perſon, under an ill habit of Body, or fearful, dies infallibly, and in a ſhort time by this Venom without ſpeedy help. In the extream Nervous Parts, near the Pulſe and Tongue, the Bites are dangerous, and the Accidents very painful. Freſh *Vipers* that have not bit, but have the Bladders of the Gnms full of Venom, are the moſt Miſchievous: Wherefore Mountebanks, to impoſe upon the People, either make their *Vipers* bite before they bring them out; or with a Needle ſcratch the Gums, and Preſs out the Poiſon.

The Remedy for theſe great and painful Swellings is, to drink the Decoction of *Marrubium*, or the Powder taken inwardly, and a Fomentation with the Decoction, applying a Cataplaſm, made with *Marrubium*, *Tapſus Barbatus* and *Agrimony* on the place. *Ariſtolochia* is alſo a ſtrong and powerful Antidote againſt the *Viper*; ſo that if one be bit on the Tongue, he need only take a ſlice of this Root, heat it and apply it, and it goes away.

Pontæus, a Chymical Mountebank (from whom I had the above-mentioned Obſervations) compoſed his Antidote of Extract of *Juniper-Berries* drawn with a Decoction of Roots of Round *Ariſtolochia*, of *Succiſa*, *Marrubium Album*, Flower of *Brimſtone*, and of *White Vitriol*. For Poiſon not corroſive, ſuch as thoſe of Animals and Vegetables, and even for the Plague it ſelf, (which he believes he can cure by the ſame Remedy) he makes uſe of no *Vitriol*: But if the Poiſon be *Sublimate*, which of it ſelf excites Vomiting, he adds *Vitriol*; not in a proportion to Vomit, as a Drachm, but only a Scruple or half a Drachm, the Vomiting being aſſiſted by the Corroſive Poiſon it ſelf.

To encreaſe the Value of this Antidote with the People, when the Experiment is made on Dogs, to that Dog which they would have die of the Bite of the *Viper*, he gives with the Antidote a Quarter of a *Nux Vomica* not powdered but only cut in Bits, and the next Day the Dog dies. If it were powdered the Dog would die in half an Hour. He ſays, *Nux Vomica* never Vomits but ſhuts up the Stomach, and Contracts the Nerves by its Poiſon. To preſerve the Dogs alive, you muſt give them with the Antidote or any thing elſe, three or four Grains of *Sublimate*, which immediately ſets them a Vomiting, and ſo ſaves them alive.

He offers to take all ſorts of Poiſons, even Corroſives, after an ordinary Meal; and for trial of Skill he refuſes them not on an empty Stomach. He much eſteems *Morſus Diaboli*, *Succiſa* or *Devil's-Bit*, againſt all ſorts of Poiſons. He laughs at the Poiſon of a *Toad*, which he ſays has none at all, no more than a *Frog*.

The manner of the acting of the *Vipers* Poiſon is thus: In about three quarters of an Hour, a Syncope, or Swooning, ſeizes them with Trembling, and Convulſions, Tingling of the Ears, and frequently Deafneſs for a Moment, next as it were a white Sail comes before their Eyes, which ſoon vaniſhes: On the place of the Bite a Swelling riſes, at firſt of the bigneſs of a *Pea*, which grows as big as a *Bean* or a *Nut*, and increaſing inlarges its ſelf over the neighbouring Parts, to a very conſiderable Tumour and ſtretching of the Fleſh, which grows *œdematous*, and by little and little falls into the *Scrotum*, and leaves the part Black, Blue and Yellow. It makes as it were Bags in the Skin which feel heavy when you Walk, as if fill'd with Quick-ſilver. Do what you will, the Poiſon will have its Courſe; and it is uſually three Days before it comes to the heighth, and as long abating.

He ſays, the Gall of the *Viper* is no ways Venomous; all the Poiſon is in a Liquor in the Gums, which is yellow like Oil; of which you may eaſily diſarm the *Viper*. The *Viper* is moſt venomous of *Serpents*; the *Aſp* is but a Species of the *Viper*. The *Napellus* is a very dangerous Poiſon, acting by its Acrimony; but you muſt take a great quantity of it. It burns the Throat extreamly, as does *Allum*; but it is cured by the Antidote. *Crude-Antimony* does nothing if attacked by the Antidote.

The moſt miſchievous of all Poiſons is *Opium*; of which having given an Exceſſive Quantity to a Servant, at firſt he had Convulſions; then ſtrange Vomitings, not able to let any thing go down into his Stomach; a Sleepineſs following; all which time they kept him Awake as much as poſſible. At laſt all of a ſudden, he grew well, and called for Victuals.

A Salamander, *by* S. Steno, *n.* 21. *p.* 377.

L. M. *Steno* writes from *Rome*, that a Knight called *Corvini* had aſſured him, that having caſt a *Salamander*, brought him out of the *Indies*, into the Fire, the Animal thereupon ſwell'd preſently, and then Vomited ſtore of thick ſlimy Matter, which did put out the neighbouring Coals, to which the *Salamander* retired immediately, putting them out again in the ſame manner, as ſoon as they rekindled; and by this means ſaving himſelf from the force of the Fire for the ſpace of two Hours; that afterwards it lived nine Months, that he had kept it eleven Months, without any other Food, but what it took by licking the Earth, on which it moved, and on which it had been brought out of the *Indies*, which at firſt was covered with a thick Moiſture, but being dried afterwards, the Urine of the Animal ſerved to moiſten the ſame; but being put upon *Italian* Earth it died three Days after.

Obſervations on a Cameleon, *by Dr.* Jonath. Goddard, *n.* 137. *p.* 930.

LI. This *Camelion* was a Female; the Skin appeared mixt of ſeveral Colours like a Medly-Cloth; lighter towards the Belly, otherwiſe near upon it, equally mixed. The Colours diſcernible are Green, a ſandy Yellow, and deeper Yellow towards a Liver-colour; and indeed one may eaſily fancy ſome mixture of all or moſt Colours in the Skin; whereof ſome are more predominant at ſometimes. There are ſome permanent black Spots on the ridge of the Back, and on the Head. Upon Excitation, or Warming, ſhe becomes ſuddenly full of black Spots of the bigneſs of a great Pin's Head equally diſperſed on the ſides, with ſmall black Streaks on the Eye-lids; all which afterwards do vaniſh. The Skin is grained with Globular Inequalities, like the Leather called *Shagreen*. The groſſeſt Grain is about the Head, next on the ridge of the Back, next on the Legs, on the Sides and Belly fineſt; which perhaps in ſeveral Poſtures, may ſhew ſeveral Colours, and when the

Creature is in full Vigour, may alſo have in ſome ſort *Rationem Speculi*, and reflect the Colours of Bodies adjacent: Which, together with the Mixture of Colours in the Skin, may have given Occaſion to the old Tradition of changing into all Colours.

The Eyes reſemble a *Lens*, or *Convex-Glaſs*, ſet in a Verſatile Globular Socket; which ſhe turned backward, or any way, without moving her Head. And ordinarily, the one a contrary or quite different way from the other. The Tongue (which ſhe was never ſeen to put forth of late, though ſhe often opened her Mouth wide) was eaſily drawn out, when ſhe was dead, to half the length of her Body, being round and full towards the End, like a Peſtle, with ſome Cavity at the Extremity: Having a Bone about half the length of it, toward the Root; over which alſo the Fore-part would ſlip backward. The Bone, where connected to the Body, is Bifurcated. She hath Teeth plainly to be felt and ſeen above and below, on the whole Circumference of the Jaw.

The Trunk of the Body, for the Structure of it, is all *Thorax*, or Breaſt, having Ribs from the Neck to the ſetting on of the Tail. The Ribs are of two ſorts; the larger above tending backward from the *Spine*, or Back-bone; the other, from the Extremities of the former, tending forward, as in the Breaſts of Fowls. There is a kind of Diaphragm, a thin tranſparent Membrane, as in Birds, ſeparating a ſmall Portion, about the fourth part of the Cavity next the Belly, from the reſt: Wherein is contained a ſmall Ventricle connexed to the *Gula*; to which is continued an Inteſtine, having ſome little Convolution in the Conveyance of it; which extended might be about the length of the whole Body, with Head and Tail. The Excrements therein black, or of a ſad *French* Green. She had a ſmall thin Liver contiguous to the upper part of the Diaphragm, in part divided into two Lobes, of a blackiſh, or very ſad Colour. The Lungs ſeemed to be made of membraneous Cells, or Diviſions, very thin and tranſparent, reſembling a little light Froth. The Heart was firm and fleſhy, but very ſmall; and at the very fore End of all the Breaſt, or Body. At the hinder End of the Body was a double *Ovary*, conſiſting of five or ſix Eggs (of the bigneſs of the greateſt Pin's Heads, and ſticking to the Back) on each ſide; of the ſame Colour and Conſiſtence with thoſe of the Yolk of an Egg.

Obſervations about the Lungs of Frogs, by S. Malpighi, *n.* 71. *p.* 2149.

LII. I am very much ſurpriſed that Mr. *Thurſton* in diſſecting of Tortoiſes, Lizards, and Frogs, did not find out the Communications between the Bronchiæ and the Lungs, calling them Bladders produced from the Laxity of the external Membrane of the Lungs; when only by putting a Pipe into the Trachea, and blowing Air into it, the Lungs which are joined on to it, grow turgid every where about the Heart; and this happens whenever the Animal has a Mind. If you diſtend them with Air, tie them with a Thread, and afterwards dry them, upon cutting into them, you will evidently ſee the membranous Cells and Veſicles. And although in Frogs the Courſe of the *Bronchia* is but ſhort, yet there are two Ducts coming from the *Larynx*, compoſed of ſemicircular Cartilages, opening into the Veſicles; and thus Reſpiration is carried on. But in the *Tortoiſe*, *Lizard*, and ſuch like Animals, the Air is conveyed into the Veſicles of the Lungs, by means of a pretty long *Trachea* divided into two Branches. I know that in *Frogs*, near the Mouth, there open two Veſicles ſome times turgid with Air (but at a good Diſtance from the Lungs) which are Appendages of the Cheeks, and are ſometimes puſhed outwards by the Air ſent from the Lungs in Exſpiration into the Cavity of the Mouth. You muſt know the Reticular Muſcles placed about the Lungs, whoſe fleſhy Plexuſes ſurrounding the Sinuſes and Veſicles, I have given a rough Draught of elſewhere. Its extraordinary Texture appears plainly in *Frogs*, and eſpecially in *Lizards*; for a great many fleſhy Fibres are produced lengthwiſe, and others running a-croſs are continued into one another, while the intermediate Spaces are occupied by reticular Plexuſes, almoſt in the ſame Manner as in the Leaves of Trees. Laſtly, theſe intermediate Spaces are occupied by ſtreight Fibres from the Reticular Muſcle, like little ſhort Tendons. This extraordinary Muſcle not only ſurrounds the Lungs externally, but likewiſe the moſt internal Veſicles and Sinuſes, ſo that by compreſſing the whole Lungs in its Action, it promotes Reſpiration and Sound. The ſame Structure is obſerved proportionally in the Lungs of perfect Animals, and eſpecially in the ſmalleſt Lobules of thoſe of Lambs, when they are diſtended with Air, and ſtill ſoft.

The Production of Tadpoles, by Mr. Rich. Waller, *n.* 193. *p.* 423.

LIII. *Mar.* 12, 1689, I took ſome *Frog-Spawn* out of a Ditch, which I ſuppoſe might have been ſpawned about fourteen Days, and kept it in a Gally-pot of Water; which I ſhifted every Day or two, and kept them in a Window where the Sun ſhined ſome part of the Day. At the firſt, they appear'd as in *Fig*. 217. being a round black Globule, encompaſs'd with a clear Liquor, as I afterwards found, and a Membrane encompaſſing that Liquor, and that encompaſſed with a larger Sphere of a more mucous Liquor. The ſecond Day they appear'd as *Fig*. 218. The third Day as *Fig*. 218. The fourth Day as *Fig*. 219. About the ſixth Day, ſeveral of them were looſed from their Eggs, and on the ſeventh and eighth more of them; when they appear'd of the ſhape of *Fig*. 220, which in *Fig*. 221, is repreſented bigger than the Life, that the Poſture they lay in may be ſeen the better. On the ſeventh and eighth Days, upon pricking of them with the Point of a Needle, they would contract themſelves; ſome of them, on the eighth Day, would of themſelves bend their Bodies, but not move out of their Place. When they firſt got thro' their Egg (which I ſuppoſe they did by eating their Way) they hung faſt upon the outſide of it, by that Part which I afterwards found to be their Mouth, and when looſed from their hold, they ſunk to the bottom of the Water, and could not riſe again. On the ninth Day they were not viſibly increaſed in bulk, only they moved themſelves more freely at the bottom of the Veſſel.

Fig. 217.
Fig. 218.
Fig. 219.
Fig. 220.
Fig. 221.

At about fourteen Days end they appeared as *Fig*. 222, at which time they ſwam about in the Water by moving their Tails as *Fig*. 223, and ſome Rudiments of their Fore-legs were viſible, which looked forked and like the Sprig of a Plant. At three Weeks end their Mouths were to be ſeen, which they opened and ſhut, and emitted *Fæces* from the other end. At a Months

Fig. 222.
Fig. 223.

end the Eyes were to be diſcerned, at which time they would ſwim near the Top of the Water, and opening their Mouths let out a ſmall Bubble of Air, and I ſuppoſe take in freſh.

The Liquor which was contained in the innermoſt Membrane, was more tranſparent than the other, which was a mucous Liquor, and like the white of an Egg, the whole was a little heavier in ſpecie than Water ; for a ſingle Egg ſunk when looſed from the reſt ; but when they were faſtened a great many together, they ſwam, every three Eggs, leaving a little ſpace, which being fill'd with Air, made them ſpecifically lighter than common Water.

The Stomach of a Leech, by Dr. Edw. Tyſon, n. 144. p. 33.

LIV. The *Ductus Animalis* in Animals, from its uſes, may ordinarily be divided into four Parts. 1. That which conveys the Food, as the *Œſophagus*. 2. That which digeſts or corrodes it, the *Stomach*. 3. That which diſtributes the *Chyle*, the *Inteſtine*. 4. That which empties the *Fæces*, the *Rectum*. But a *Leech* is all Stomach, from one end to the other, and does devour at a Meal ſeveral times the Weight of its whole Body. The Stomach when ſwelled and ſtretcht with Blood is far bigger than the *Leech* it ſelf, nay, ſeveral times exceeds it. But I miſtook the number, it was not one, but many Stomachs ; for the Cavity is divided into ſeveral tranſverſe Membranes, in divers diſtinct *Camera*'s, but theſe Membranes in the middle have a Hole that leads from one into the other ; but by the pouching out of each ſide, each of theſe may be reckon'd alſo two ; in all we may number, (there being ten or twelve of theſe *Camera*'s, beſides theſe two long ones which at laſt run to the Tail) at leaſt twenty-two, if not twenty-four Stomachs. But the *Rectum*, which lies between the Forking of the two laſt *Sacculi*, or Stomach, is but ſmall, and ſhort in Reſpect of the whole.

The Anatomy of a Leech, by M. Fr. Poupart, n. 233. p. 722.

LV. The upper Lip of a *Leech* is ſtretched out into a Point, and falls upon the under, which is round like a *Creſcent*, and ſhorter. Its Throat on the inſide is covered with a great many white Muſcles, about five or ſix Lines long, as big as a ſmall Thread, and lying parallel one to another, along its Body. When it applies the Mouth to the Fleſh of any Animal, all theſe Muſcles contracting themſelves, ſhe ſucks it with ſo great Violence and Greedineſs, that ſhe makes it enter in Form of a little Pap into its Throat. So that all the Effects of Suction terminating in a very little Space, of neceſſity the Fleſh muſt break in that Place.

There is ſeen at the end of its Tail, a little flat thing, exactly round, the Border of which is elevated far above the Tail, and all round it ; which it applies ſo uniformly upon the Bodies to which it faſtens it ſelf, that it touches them in all their Parts, and then drawing up a little the middle of this flat part, without taking off the edges, ſhe makes of it, as it were, a little *Balm*, which leaves its Cavity in its middle. This excellent Glue faſtens ſo ſtrongly on the Tail of the *Leech*, that 'tis a hard Matter to pull it away without making ſome Rent, eſpecially if you draw it perpendicularly from the Surface on which the Animal is faſtened. It has always Recourſe to this little Inſtrument, for faſtening its Body, to the End it may not be ſuſpended in the Air, while it draws Nouriſhment by Suction, or elſe that it be not carried away with the Current of the Water, while it carries its Head here and there for ſeeking its Nouriſhment.

Its Gut goes in a ſtraight Line from the Mouth to the *Anus*, as big as a Gooſe's Quill, all along ſet with a great Number of little Valves: Some of which make a perfect Circle, with a Hole in the middle, and others a half-Moon; ſome are ſharp'd Spiral-ways; and there is a great one of this ſort near the Tail, faſhioned like the *Heart*, which leaves only a very little Hole, near which is found much *yellow Fat*, which fills all the Cavity of the *Inteſtine* to half an Inch. Two little *Inteſtines* or *Appendixes*, each half an Inch long and of the Bigneſs of the Feather of a little Bird's Wing, pierce the great Gut, in which they are open at one End, and ſhut at the other. All this Structure makes it evident, why the *Inteſtine*, which makes no Convolutions, and yet reſerves ordinarily but liquid Aliments, does yet retain them to a perfect Concoction.

A *Nerve*, the Bigneſs of a *Horſe-Hair*, all black, hard to break, having *Knots* at a Diſtance one from the other, beginning at the Mouth of the Animal, paſſes over the Parts that ſerve for Generation in the Male; 'tis faſtened in a ſtraight Line all along the Gut above, ends at the little Circle in the End of the Tail, and in the Way ſends out Branches to the right and left Side, which go from every Knot. 'Tis very probable, that by this Canal, the Animal Spirits run abundantly, which gives ſo great Briſkneſs to this Reptile, which makes it ply into ſo many Faſhions, ſwim ſo ſwiftly, ſo properly, and ſuck with ſuch Greedineſs.

The *Leech* is Hermaphrodite, the Parts of the Male deſtinated to Generation are placed where the Neck ought to be. The *Yard*, which is about two Inches long, is white, round, hollow and griſtly: A part of the Yard, which is always in the Body, is a Sheath, about 17 Lines of an Inch long, as big as a little Bird's Quill, covered with a fine Membrane, which faſtens it ſtrongly to the Belly, round about a little Hole given the *Leech* for putting out and in his Yard when he pleaſes, and not for Breathing as the Ancients ſaid. The other Part of the Yard which comes out nine or ten Lines of an Inch, is the bigneſs of a ſowing Thread, and the End of it, for the Length of two Lines, is bigger than the reſt. All the Yard is hollow, and has in his Cavity a white Muſcle as big as a Hair, faſtened only to the Root and Head, all the reſt being at *Liberty*. 'Tis with this Muſcle that the Animal draws the Yard into its Sheath, which any one may try by Cutting it at the *Root*, to draw out this Muſcle with his Nails. On every ſide of the Root of the Yard is a little white Web, flat, oval, about two or three Lines long, reſembling ſmall Guts, twiſted about with a Cartilaginous Body, as big as a double Thread, and two Lines long, which faſtens to the Root of the Yard, in which 'tis probable it carries the Prolifick Matter. A little above the Root of the Yard between theſe two Webs, there is a little Griſtly Globule, two Inches long, white, hard, hollow, round, oval, ſharp, inwardly covered with a Membrane, wrinkled and full of a milky Liquor. There is at the Head of this Globule a ſmall Web, like to an *Epididymis*, whoſe little *Canal*, of the ſame Piece with it, creeps over the Globule, and is faſtened at the Point of it, and above the *Epididymis* are two *Glands* exactly round, each as big as a Grain of *Millet*. I take this little Globule to be a Teſticle. All along every ſide of the *Inteſtine* is a white Canal, or *Ovarium*, of the bigneſs of a ſmall twiſted Thread, and folded in a thouſand Manners, to which are faſtened with a Tail, as it were the Grain of a Raiſin to their Grape, many little Globules exactly round, as big as a little Pea, full of a milky Juice, and ſome little white Eggs, griſtly, perfectly round, as big as a Grain of *Millet*, hard, which are hardly broken, making a Noiſe, and full of a white Matter. There is in the *Inteſtine*, towards the End, a great Valve faſhioned like a Heart, with two little Bags, where begin 1000 ſmall Channels made of fine yellow Fat which fill the Cavity of the *Inteſtine* for half an Inch. It's probable that theſe Paſſages of Fat receive the Prolifick Liquor to conduct it into the *Ovarium*.

An extraordinary Leech which torments the Sword-fiſh; by S. Paulo Boccone; *n.* 99. *p.* 6159.

LVI. There is an extraordinary *Sanguiſuga* or *Leech*, found ſometimes ſticking faſt in the Fiſh call'd *Xiphias*, or *Sword-fiſh*. *S. Boccone* gives it the Name of *Hirudo*, or *Acus Cauda utrinque pennata*, becauſe of its working it ſelf into the Fleſh, and ſucking the Blood of the ſaid Fiſh. He deſcribes it to be of about four Inches long, the Belly of it white, cartilaginous and tranſparent, without Eyes or Head, (that he could obſerve) but inſtead of a Head, it had a hollow Snout, encompaſſed with a very hard Membrane, differing in Colour and Subſtance from the Belly; which Snout it thruſts whole into the Body of the Fiſh, as ſtrongly as an *Augre* is wound into a piece of Wood, and fills it full of Blood unto the very Orifice. It hath a Tail ſhaped like a *Feather*, ſerving for its Motion, and under it two Filaments, or ſlender Fibres, longer than the whole Inſect, whereby it ſeems it clings about Stones or Herbs, and ſticks the cloſer in the Body of the *Sword-fiſh*, of which it attacks thoſe Parts only where the Fins of the Fiſh cannot touch or trouble it, the Obſerver affirming that he hath often found it ſticking in the Back, and in the Belly, and ſometimes cloſe to the Head, ſometimes cloſe to the Tail of that Fiſh, but always far enough from the Fins. Within its Belly he noted ſome Veſſels like ſmall Guts, reaching from one end of it to the other, which by the Preſſure of his Nail, he made reach to the Orifice of the Snout, whence they retired back of themſelves to their natural Situation; they ſeeming to be the Inſtruments for ſucking the Blood, becauſe the Snout is in it ſelf an empty part, deſtitute of Fibres and Valves, to draw and ſuck with; whereas theſe Veſſels having a Motion reſembling that of a Pump, in which the Snout of this Animal ſerves for a Sucker, drawing the Blood from one end to the other: And the Belly of this Inſect being fram'd Ringwiſe, the Structure ſerves to thruſt the inner Veſſels into the Orifice of the Trunk, and to draw them back again.

This Creature as it torments the *Sword-fiſh*, ſo it is, by our Obſerver's Relation, vexed it ſelf by another Inſect, which he calls a *Louſe*, of an Aſh-Colour, faſtened toward the Tail of this Leech as firmly as a Sea-ſnail is to a Rock. 'Tis of the Bigneſs of a Pea, and hath an Opening, whence come out many ſmall winding and hairy Threads. It hath not been obſerved, (as far as our Author could learn) to trouble, or to be upon any other Animal than this *Leech*.

The odd Turn of ſome Shell-Snails, by Dr. M. Liſter. *n.* 50. *p.* 1011. *n* 72. *p.* 2171.

LVII. I have found two ſorts of *Shell-Snails* eaſily diſtinguiſh'd one from another, and from all beſides, becauſe the Turn of the Wreaths is from the Right Hand to the Left, contrary to what may be ſeen in common *Snails*. They are very ſmall, and therefore might well eſcape thus long the more curious Naturaliſts; neither of them much exceeding, at leaſt in Thickneſs, a large *Oat-Corn*.

The firſt I thus deſcribe. The Open of the Shell is pretty round; the Second Turn or Wreath, is very large for the Proportion, and the reſt of the Wreaths, about the number of ſix, are ſtill leſſened to a Point. This *Turben*, or Conical Figure, is well near a Quarter of an Inch; the Colour of the Shell is duſkiſh, yet when the ſhrunk Animal gives leave, you may ſee Day through it, and then it is of a yellowiſh Colour. Theſe Shells are extream brittle and tender.

The ſecond ſort ſeem to be much ſtronger and thicker ſhell'd, they are well near half as long again as the other, and as ſlender, they have the exact Figure of *Oat-Corn*, being as it were, pointed at both Ends, and the Middle a little ſwelled. The Open of the Shell is not exactly round, there being a peculiar Sinus in the lower part thereof. I think you may number about ten Spires, having their Turn from the Right Hand to the Left. The Colour of the Shell is of a dark and reddiſh Brown.

Both theſe ſorts of Snails when they creep, lift up the Point of their Snalls towards a Perpendicular, and exert, with Part of their Body, two pair of Horns, as moſt of their Kind do.

Cat. Plant.

In *March* I have ſeen many of them pair'd, and in the very Act of Venery, and therefore it is moſt certain, (contrary to the Opinion of *Ariſtotle*) that they engender. But whether thoſe that are thus found coupled, be one of them Male and the other Female, or rather, as Mr. *Wray* hath obſerved, that they are both Male and Female, and do, in the Act of Generation, both receive into themſelves, and immit a like *Penis* (as it ſeems probable to any Man that ſhall part them) I ſhall not determine.

Theſe *Snails* are to be found frequent enough under the looſe Bark of Trees, as old *Willows*, and in the ragged Clefts of *Elms* and *Oaks*, &c. and in no other Place that I could obſerve.

Some ſort of Virginian Snails; *by Mr.* J. Baniſter, *n.* 198. *p.* 671.

LVIII. 1. The Outſide of one ſort of *Land-Snails* in *Virginia*, is of Aſh-colour, inclining to a yellow, the Inſide white, with a bluſh of red, and in the middle of the Entry, on the Inturn of the Shell, grows a ſmall white

Tooth, or Protuberance. But what is moſt remarkable, the Shell it ſelf is tranſparent, and you may plainly perceive by the Opacity there, that the Body of the Animal lies near the ſpiral String, or Center, on which the Arch is turned, and that the empty part of the Shell is ſpread with a thin ſpotted Film. Near the Tooth, but more inward, is to be ſeen a little wateriſh Speck, which by a kind of *Syſtole* and *Diaſtole*, contracts and dilates it ſelf; from this proceeds a limpid Trunk, which runs into the *Film*, and there divides into Branches; theſe grow leſſer, and ſpread as the Animal recedes, or approaches the Mouth; and when it is out, extend themſelves to the very Lip of the Shell. I ſuppoſe the ſame to be in all, at leaſt the Land-kind, tho' not eaſily to be diſcerned. It is likely alſo, that the *Film*, the *Nautilus* or *Carvil* (as the Sailors call it) exerts, may be analogous to this.

By Dr. Liſter, ib. 2. This Deſcription of the Heart of a *Snail*, agrees well with the Anatomy thereof, made and long ſince publiſhed by *Harder*, and *Fr. Redi*.

By M. Baniſter, ib. *p.* 672. 3. There is a ſmall *Snail* of the Land-kind, with a dented Aperture, and an outward Coat, on which it is *Hirſute*, or rather finely echinated. I am apt to believe, that theſe (or hardly any elſe) are not dented, till they are at their full Growth, for I find ſeveral ſmall ones amongſt them, with an open entrance, that ſeem to belong to this kind.

I have hitherto obſerved very little variety of naked *Snails*, I know of but one kind, which is a ſmall Aſh-colour'd and ſpotted one, and milky, like Dr. *Liſter*'s, Fig. 16.

The Purple-Fiſh, by Mr. Will. Cole, *n.* 178. *p.* 1278. LIX. In *October*, 1684, There were two Ladies at *Minhead* where I then was, who told me, that there was a certain Perſon living by the Sea-ſide in *Ireland*, who made conſiderable Gain, by marking with a delicate durable Crimſon-colour, fine Linen of Ladies, Gent. *&c.* ſent from any Parts of that Iſland, with their Names, or otherwiſe, as they pleaſed, which was made with ſome liquid Subſtance taken out of a *Shell-fiſh*, and one of them thought it to be taken out of the Shells here figur'd and deſcrib'd. Hereupon I made many Experiments on all the Shell-fiſhes I had taken on that Coaſt; and at laſt obtained that delicate Colour they told me of. The whole Proceſs is as followeth: *Fig.* 223, 224, 225, 226, 227, 228.

The Shells being harder than moſt of other kinds, are to be broken with a ſmart ſtroke with a Hammer, on a Plate of Iron, or firm Piece of Timber, (with their Mouths downwards) ſo as not to cruſh the Body of the Fiſh within; the broken Pieces being pick'd off, there will appear a white Vein, lying tranſverſly in a little Furrow or Cleft, next to the Head of the Fiſh, which muſt be digged out with the ſtiff Point of a Horſe-hair Pencil, being made ſhort and tapering. The Letters, Figures, or what elſe ſhall be made on the Linnen (and perhaps Silk too) will preſently appear of a pleaſant light Green-colour, and if placed in the Sun, will change into the following Colours, *i. e.* if in Winter, about Noon, if in the Summer, an Hour or two after Sun-riſing, and ſo much before ſetting; for in the Heat of the Day, in Summer, the Colours will come on ſo faſt, that the Succeſſion of each Colour will ſcarcely be diſtinguiſh'd ; next to the firſt light green, it will appear of a deep-green, and in few Minutes change into a full Sea-green, after which, in a few Minutes more, it will alter into a Watchet-blue; from that, in a little time more, it will be of a purpliſh Red, after which, lying an Hour or two, (ſuppoſing the Sun ſtill ſhining) it will be of a very deep purple-red, beyond which the Sun can do no more. But then the laſt and moſt beautiful Colour, after waſhing in ſcalding Water and Soap, will, (the Matter being again put into the Sun or Wind to dry,) be of a fair bright Crimſon, or near to the Prince's Colour, which afterwards, notwithſtanding there is no uſe of any Stiptick to bind the Colour, will continue the ſame, if well ordered; as I have found in Handkerchiefs, that have been waſh'd more than forty times; only it will be ſomewhat allay'd, from what it was, after the firſt waſhing. While the Cloth ſo writ upon lies in the Sun, it will yield a very ſtrong and fœtid Smell, as if *Garlick* and *Aſſa Fœtida* were mixed together.

The Shells are of divers Colours, but moſt of them white, ſome are red, ſome yellow; others of both theſe Colours; ſome of a blackiſh brown; many of a ſandy Colour, and ſome few ſtriped with white and brown parallel Lines. It ſeems to be a kind of *amphibious Animal*, alternately living in both Elements every Tide: For being out of their native Place, and in Want of ſuch Viciſſitudes, they take this Courſe to find the Air; when any of them are put into a Veſſel of Sea-Water (for in freſh they ſoon expire) after they have lain ſome time in the bottom of the Veſſel, they creeping to the Superficies of the Water, and by extending a kind of Lip, with their *Operculums*, cling to the Side of the Veſſel or Pan, (which is moſt convenient for their Aſcent) with about half that Part above the Water; ſometimes creeping down under it, and returning again to their Station between Wind and Water. *Fig.* 229.

I have found that ſometimes their Veins are fuller and whiter, and the Juice more viſcid, at other times more flaccid and watery.

Theſe Shells are in great abundance in the Sea-Coaſt of *Somerſetſhire*: I have found them alſo on the Shoars of *South Wales*, oppoſite to it; and I doubt not, but they may be found on the other Coaſts of *England*, eſpecially the *South* and *Weſtern* Parts, where I am almoſt aſſured, I have formerly ſeen them, tho' then unknown to me. And I am of Opinion, there may be found on our Marine Coaſts, ſome bigger Shells, which may have a colouring Juice, though not the ſame with this, for that I know few natural things both of Animals and Vegetables, but what have divers ſorts of the ſame kind, in the ſame Place.

I am aſſured by ſome, who have boil'd, dreſs'd, and eaten of this Fiſh, that they are wholeſome Food; as good at leaſt, and taſte as well as *Lympots* or *Winkles*, only the Fleſh is ſomething harder.

Perhaps this colouring Juice may be the ſpermatick and prolifick Matter, by which they propagate their Kind; which I am inclinable to think, from its Conſiſtence, Virulent and Fœtid Savour. Or elſe it may be a Humour in this Animal, which by its vital Energy, as the Spring of Life and Motion, ſupplies the Want of Heart, Liver, Blood, &c. as in other exſanguineous Animals.

There are many ſorts of this Purple Fiſh, differing in bigneſs, ſtructure, colour of the Shell, according to the Nature of the Sea-Grounds, Depth or Shallowneſs of *Water*, *Rocks*, *Gravel*, *Mud*, as alſo the Latitude, where they are found; and ſo differing alſo in the *Varieties* of *Colours* of the *Tinging Juice* in their Veins, as *black*, *livid*, *violaceous*, *deep Sea-green*, *light* and *deep Red*, *Amethyſtine*, &c. But the beſt of all were found in the *Tyrian Seas*, near the Iſland on which the renowned City of *Tyre* was built, (now an inconſiderable Town called *Sur*;) this was celebrated and priz'd above all the reſt, for that it excelled them all in its illuſtrious Colour, called in former Ages by divers Names; as *Oſtrum*, *Sarranum*, *Pelagium*, *Venenum*, *Tyrium*, *Purpuriſſum*, *Flores Tyriani*, &c. Almoſt all Authors agree, that it lies in a certain Vein in the *Fiſh*; and ſome of them mention it to be white and viſcous, as this of ours is. This excellent *Dye* ſeems to have arrived at its higheſt Perfection in the Days of *Pliny* (being in the Reigns of the *Veſpaſians*) when the Artiſts of the Imperial City of the World, in Preparations of that *Tinging Succus* for *dying* the Robes and other Veſtments of *Emperor*, *Senators*, &c. ſtrove to excel each other in new-faſhion'd Purples, to gratify the luxuriant Exceſs of the Great Ones of thoſe Times, by preparing and mixing the Colour found in the ſeveral ſorts of theſe Shells. Theſe Colours ſold then at great Prices; that which was the fine double dy'd Purple of *Tyre*, called *Diabapha*, yielded 1000 *Roman Denarii* the Pound, which is computed to be more than 30 *l. Sterling*: And this of ours being ſo excellent a Colour, without a Preparation, or Addition of any thing to it may now, or at leaſt hereafter, by farther Improvement, vye with the *Tyrian Purple*.

Johnſton, out of *Ariſtotle*, mentions a Species of theſe Fiſhes, under the Name of *Littorales quæ parvæ & Flore ſunt rubro*; this agrees with ours, which may be named *Purpura Littoralis* (*ſive Tenienſis*) *parva Turbinata*.

Obſervations on a Tortoiſe; by Sir. Geo. Ent. n. 294. p. 533.

LX. *October* 7, 1651. I weighed my *Tortoiſe*, before he was put into his Hole, where he was to remain all Winter, and he weighed exactly four Pounds, three Ounces, and ſeven Drachms.

October 8, 1652. I had him dug up (for he had buried himſelf the Day before) and weighed a-new, and he weighed four Pounds, ſix Ounces, and one Drachm.

March 16, 1652-3. The *Tortoiſe* came out of his Hole of himſelf, and he weighed five Pounds, four Ounces.

October 4, 1653. The *Tortoiſe*, after having faſted for ſome Days, and hid himſelf under Ground, being taken up, weighed four Pounds, five Ounces, and his Eyes (which had been long ſhut) being then open were very moiſt.

March 18, 1653-4. The *Tortoiſe* coming out of his Hole, was weighed in a Scale, and his Weight was four Pounds, four Ounces, and two Drachms.

October 6, 1654. The *Tortoiſe*, about to take up his Winter-Quarters, weighed four Pounds, nine Ounces, and three Drachms.

The laſt Day of *February* 1654-5. The *Tortoiſe* creeping out from his Hole where he had remained all the Winter, weighed four Pounds, ſeven Ounces, and ſix Drachms. He had loſt therefore an Ounce and five Drachms of his Weight.

October 2, 1655. The *Tortoiſe* going again into his Winter-Quarters, weighed four Pounds, nine Ounces. But he had faſted for ſome Time before.

March 25, 1656. The Weight of the *Tortoiſe* coming out of his Winter-Quarters, was four Pounds, ſeven Ounces, and two Drachms.

September 30, 1656. The *Tortoiſe*, about to hide himſelf again under Ground, weighed four Pounds, twelve Ounces, and four Drachms.

March 5, 1656-7. The *Tortoiſe* coming out of his Hole under Ground, weighed four Pounds, eleven Ounces, two Drachms and a Half.

Whence it appears plain of what fixed Particles theſe Animals are compoſed which fortify themſelves under Ground, againſt the Cold of Winter, ſeeing that for ſo many Months ſuch a ſmall Part of their Bodies goes of by Sweat or Perſpiration, that it may very well be queſtioned whether they live or not, while they lie buried in this Manner.

LXI. S. *Steno* writes from *Florence*, that a *Tortoiſe* had its Head cut off, and yet it was found to move its Feet three Days after *.

* *A Tortoiſe living three days without a Head, by M.* — *n.* 26. *p.* 480.

A ſort of Oiſters in Eaſt-India, *by M.* Witzen, *n.* 203. *p.* 871.

Fig. 230.

By Dr. Liſter, *ib. p.* 872.

LXII. 1. In the River of *Goa*, there is a Shell repreſented in *Fig.* 230. which holds a ſort of *Oiſter*; it is very ſcarce, and in the *Indies*, as well as here in *Holland*, the Shell powder'd is eſteem'd a good Medicine.

2. The like ſort of *Oiſter-ſhells* are to be found in the *Weſt-Indies*. And conſidering the Hint given us by M. *Witzen* of its being thought medicinal at *Goa*, where it is found; and alſo how that calcined Shells are the moſt common Entertainments all over the *Indies*, chewing them all Day long, with the Leaves of a certain hot, piperate and ſpicy Plant, and a ſort of Nut mixt therewith; we may reaſonably ſuſpect the *Goa-Stone* to be made up of them, or ſuch like Ingredients.

Shining Worms in Oiſters, by M. Auzant, *n.* 12. *p.* 203.

LXIII. 1. M. *Auzant*, at the Intimation of M. *de la Voye*, obſerved a ſhining, clammy Moiſture in *Oiſters*, which ſtuck to the Shell, and being drawn out, ſhone in the Air its whole Length, which was about four or five Lines, and being put upon the Obſerver's Hand, continued to ſhine there for ſome time. And afterwards cauſing more than twenty Dozen of *Oiſters* to be opened in the Dark, he found this ſhining Subſtance to be really Worms (as M. *de la Voye* had thought them before) and thoſe of three ſorts; one ſort was whitiſh, having twenty-four or twenty-five Feet on each ſide, forked, a black Speck on one ſide of the Head, taken by him for a *Chryſtalline*, and the Back like an *Eel* ſtripp'd of her Skin; the ſecond was red, and reſembling the common *Glow Worm*, found at Land, which folds upon their Backs, and Feet like the former, and with a Noſe like that of a Dog, and one Eye in the Head: The third ſort was ſpeckled, having a Head like that of a *Soal*, with many Tufts of whitiſh Hair on the Sides of it.

2. The Obſerver alſo ſaw ſome much bigger, that were Grayiſh, with a big Head, and two Horns on it, like thoſe of a Snail, and with ſeven or eight whitiſh Feet: But theſe, though kept by him in the Night, ſhined not.

3. The two firſt ſorts are made of a Matter eaſily reſoluble; the leaſt Shaking or Touch, turning them into a Viſcous and Aqueous Matter, which falling from the Shell, ſtuck to the Obſerver's Fingers, and ſhone there for the ſpace of 20 Seconds; and if any little Part of this Matter, by ſtrongly ſhaking the Shell, did fall to the Ground, it appeared like a little piece of Flaming Brimſtone, and when ſhaken off nimbly, it became like a ſmall ſhining Line, which was diſſipated before it came to the Ground.

4. This ſhining Matter was of different Colours; ſome whitiſh, ſome reddiſh, but yet they both afforded a Light, which appeared a *Violet* to this Obſerver's Eye.

5. He obſerved among them two more firm than the reſt, which ſhone all over; and when they fell from the Oiſter, twinkled like a great Star, ſhining ſtrongly, and emitting Rays of a Violet-Light by turns, for the ſpace of 20 Seconds. Which Scintillation the Obſerver imputes to this, that thoſe Worms being alive, and ſometimes raiſing their Head, ſometimes their Tail, like a *Carp*, the Light encreaſed and leſſened accordingly; ſeeing that when they ſhone not, he did, viewing them by a Candle, find them dead.

6. Forcibly ſhaking theſe *Oiſter-ſhells* in the Dark, he ſometimes ſaw the whole Shell full of Lights, now and then as big as a Finger's end, and abundance of this clammy Matter, both red and white, which he judges to have been Worms burſt in their Holes. And in the ſhaking he ſaw all the Communications of theſe little Verminous Holes, like to the Holes of Worms in Wood.

7. In more than 20 Dozen of Oiſters he took no Shell (10 or 12 excepted) but it emitted Light; and he found ſome of this Light in 16 of the Oiſters themſelves.

8. This Light occurs more frequently in big than ſmall Oiſters; in thoſe that are pierced by the Worm, oftner than thoſe that are not; and rather upon the Convex Side than the other; and more in freſh ones than in the ſtale.

9. Having ſomewhat ſcaled the Convex Side of the Shell, and diſcovered the Communication of the Holes, wherein the often mentioned viſcous Moiſture that has any Form of Inſects is found, he ſmelt a Scent that was like the Water of a ſqueezed Oiſter.

10. The Worms give no Light when irritated; but if they do, the Light laſts but a very little Time; whereas that which appears in thoſe that were not angred before, continues a great while; the Obſerver affirming to have kept of it above two Hours.

The Origin of Pearl; by M. Chriſtopher Sandius, *n.* 101. *p.* 11.

LXIV. The *Pearl-ſhells* in *Norway*, and elſewhere, do breed in ſweet Waters. Their Shells are like to thoſe, which commonly are called *Muſcles*, but they are larger. The Fiſh in them looks like an *Oiſter*, and it produceth a great Cluſter of Eggs, like thoſe of Craw-fiſhes, ſome white, ſome black, (which latter will yet become White, the outer black Coat being taken off;) theſe Eggs when ripe, are caſt out; and being caſt out, they grow, and become like thoſe that caſt them. But ſometimes it happens, that one or two of thoſe Eggs ſtick faſt to the ſides of the *Matrix*, and are not voided with the reſt. Theſe are fed by the Oiſter againſt her Will, and they do grow, according to the Length of Time, into Pearls of different Bigneſſes, and imprint a Mark both in the Fiſh and the Shell, by the Situation, conform to this Figure.

This Account I received from a *Dane*, called *Henricus Arnoldi*, an ingenious and veracious Perſon, having by his own Experience found it ſo at *Chriſtiana* in *Norway*, and with great Seriouſneſs aſſured me of the truth thereof.

Pearl-fiſhing in Ireland; *by Sir* Rob. Redding, *n.* 198. *p.* 659.

LXV. There are four *Rivers* in the Country of *Tyrone*, abounding with that ſort of Muſcles, wherein Pearls are found, all emptying themſelves into *Lough-Foyle*, whereon ſtands the Town of *Derry*, and ſo into the Sea. There are alſo other Rivers in the County of *Donegall*, a River near *Dundalk*, the *Shure* running by *Waterford*, the *Lough* called *Lough-Lean* in *Kerry*, which afford the like Fiſh; and no doubt, there be many more that I do not know.

In the warm Months before Harveſt is ripe, whilſt the Rivers are low and clear, the poor People go into the Water, and ſome with their Toes, ſome with wooden Tongs, and ſome by putting a ſharpened Stick into the opening of the Shell, take them up; and although by common Eſtimate, not above one Shell in an hundred may have a Pearl, and of theſe Pearls not above one in a hundred be tolerably clear, yet a vaſt Number of fair merchantable Pearls, and too good for the *Apothecary*, are offered to Sale by thoſe People every Summer-Aſſize. I my ſelf ſaw a Pearl bought for 50*s.* that weighed 36 Carats, and was valued at 40*l.* and had it been as clear as ſome others produced therewith it would certainly have been very valuable. And a Miller took a Pearl, which he ſold for 4*l.* 10*s.* to a Man that ſold it for 10*l.* to another, who ſold it to the late Lady *Glenanly*, for 30*l.* with whom I ſaw it in a Necklace; ſhe refuſed 80 Pound for it from the late Dutcheſs of *Ormond*. The young Muſcles never have any Pearl in them.

The Natives, though very foul Feeders, will not eat the Fiſh; which ſeems to me to cut like the *Oiſter*, blackiſh-green. The Shell is faſtened with two Tendons, one at each end, whereas the *Oiſter* and *Scallop* are with one only in the Middle. They lie in Part opened, putting forth their white Fins, like a Tongue out of the Mouth, which directs the Eye to them in the Water, being otherwiſe black as the Stones in the River. The Backs of the Shells, juſt about the Hinges, on which the Valves do open, are all broken and bruiſed, both young and old, and ſhew the ſeveral Cruſts and Scales that make the Shell; and is cauſed (I think till I know better) by the many great Stones that are driven over them by the Floods from the Neighbouring Mountains, which are moſt impetuous after any little Rain. The inſides of the Shell are of an Oriental and Pearl-Colour and Subſtance, like a flat *Pearl*, eſpecially when firſt opened; and I was told by an ingenious Perſon, living upon the Place, that he had obſerved in ſome Shells under the firſt Coat a Liquor that was very orient and clear, that would move upon the Preſſure of the Finger; but that ſuch a Muſcle never had a Pearl; which Liquor I ſhould think was the true *Mother of Pearl*.

The Part where the *Pearl* lieth, is in the Toe, or leſſer end, at the Extremity of the Gut, and out of the Body of the Fiſh between the two Fins, or Skins, that line the Shell. I believe that this Pearl anſwereth to the Stone in other Animals; and certainly like that encreaſeth by ſeveral Cruſts, growing over one another, which appeareth, by pinching the *Pearl* in a Vice, the upper Coat will crack and leap away; and this Stone is caſt off by the Muſcle, and avoided as it is able; and many Shells that have had Pearls in them, are now found to have none, which will appear in theſe Inſtances: The Shells that have the beſt Pearls are wrinkled, twiſted, or bunched, and not ſmooth and equal, as thoſe that have none. And the crafty Fellows will gueſs ſo well by the Shell, that though you watch them never ſo carefully, they will open ſuch Shells under the Water, and put the Pearls in their Mouths, or otherwiſe conceal them. Yet ſometimes when they have been taking up Shells, and believing by ſuch Signs as I have mentioned, that they were ſure of good Purchaſe, and refuſed good Sums for their ſhares, they found no Pearl at all in them. Upon Diſcourſe with an old Man that had been long at this Trade, he adviſed me to ſeek not only when the Waters were low, but in a duſky gloomy Day alſo, leſt, ſaid he, the Fiſh ſee you, for then he will ſhed his Pearl in the Sand; of which I believed no more, than that ſome Muſcles had voided their Pearls, and ſuch are often found in the Sand.

I conceive that theſe Pearls, if once dark, will never be clear upon any Alteration in the Health or Age of the Muſcle, or of the Moon; and that if the firſt Seed be black, all the Coats ſuperinduced will be ſtill clouded.

The Bottoms of theſe Rivers I obſerved to be part ſandy, part ſtony, and part ouzy. Many of theſe Muſcles lie in brackiſh Water; being driven down the Rivers four or five Miles within the flowing of the Sea. I have ſometimes obſerved the ſame *Pearl* clear at one end, and dark at the other.

The Anatomy of a Scallop; by Dr. M. Liſter, *n.* 229. *p.* 567.

LXVI. In the Beginning of *January*, having got a *Scallop*, I ſet about diſſecting it with as great Accuracy as I could, conſidering I never had the Opportunity before. Firſt, I obſerved the *Hinge* riſing gently crooked from the *hollow Shell*, and laid over the other upon the *plain Shell*, the two being firmly connected together on that Part with a Kind of Cartilage: And likewiſe in the middle Part of the Hinge there was another Cartilage, very black, and ſtrong: Hence ariſes that ſurpriſing Force of keeping the Shells ſhut, and perhaps of moving the *plain Shell*, like a kind of Oar, thereby to produce a certain Progreſſion, and as it were Sailing; of which the Ancients frequently talk as peculiar to this Shell-fiſh.

Upon opening the Shells we may obſerve the following. Towards the right Side, under the Hinge, the Mouth headed like that of an Oiſter. The Coverings of the Mouth are compoſed of the conjoined external *Branchiæ*, which are muſculous, and ſurround the whole Animal from the Head to the Anus, *viz.* towards the left Side from the Mouth, where they are again connected with one another.

But of that Pair of the external *Branchiæ*, the one which lies upon the plain Shell, adheres with its Center to the upper Border of the ſame large round Muſcle, which is inſerted at right Angles into the Middle of each Shell; and the other one is joined after the ſame Manner to the other central Head of the ſame central Muſcle.

Both theſe two external or ſpurious *Branchiæ* ariſing from the *central Muſcle*, conſiſt of a thin and very pellucid Membrane; and being expanded as far as the Middle of the Shells adhere gently to them, ſo as they cannot ſlip from thence, defending the Back of the Animal from the Injuries of the Water contained within the Shell; while from the Place of that Adheſion, a very ſingular thick Muſcle, in the Faſhion of a Skirt, takes its Origin. I have painted that Muſcle only as it is when not expanded; but in the living Animal it is very extenſive, even ſo as to reach far beyond the Margin of the Shell. It is fringed too as it were, and beautifully variegated with little red Lines. Several Days after this Scallop was taken up, you could obſerve that Skirt evidently to move. The Uſe of the Skirt, I imagine to be this, *viz.* by being crooked inwards while contracted, after the Manner of a Kind of Net, when theſe two Branchial Muſcles are thruſt out without the Shell, whatever gets between them, being applied together, they carry in with them for the Nouriſhment of the Animal: While by the Fringes upon the Margins, the Sea Water ſeems to be ſeparated, and the Food ſtill retained. I don't know that that Part has any other Uſe. I might add however, that this Skirt may poſſibly ſerve, by its ſtrong Compreſſion, to kill a ſmall Animal or little Fiſh; and by its *undulatory Motion*, which in it is very remarkable, may move about the Food; and, in whatever Part of the circular Net it was contained, convey it at laſt into the Mouth, thus in ſome Meaſure performing the Office of a Hand.

But I come now to the true *Branchiæ*, at leaſt they are uſually called ſuch, and they are four in Number, a little upon the yellowiſh, and ſtreaked very elegantly in the Manner of the Teeth of a Comb. Theſe *Branchiæ* ſurround the great *central Muſcle*, and contain betwixt them, or lie upon the *Uterus* with its *Ovarium*, at leaſt Parts deſigned for Generation. I gave Figures of theſe Parts formerly which were very juſt, and now alſo in the living Animal I ſee the lower Part of a Saffron Colour, and the upper Part whitiſh, and near the Mouth a Proceſs with a double Foramen. One of theſe Foramina is the Orifice of the Vagina; and if the *Scallops* are *Hermaphrodites* (which I ſuſpect from the conſtant Similitude of *that* Part in all that I have ſeen of them, whether alive or pickled) the *other* is deſigned for the Penis to come out at.

I proceed next to the *Head*; and its *Mouth* is circumſcribed with reddiſh *Lips*, after the Manner of the Internal *Branchiæ*, very ſhort, and in this *Scallop* crumpled, very much diſeaſed and mangled. Under the Middle of the Hinge are two pretty large Circles or Cavities like the *Eyes* (and they probably are Eyes) of a *Turbet*, placed obliquely.

The *Mouth* and *Head* are pretty large, turned towards the left Side, and full as it were of a blackiſh *Meconium*. Behind it lies the Heart, which you can ſee through the pellucid *Pericardium*, of a fleſhy Colour ſomewhat red. The *Aorta* ariſing from the Heart is diſtributed through the *Branchia*. But I am in a Doubt whether that only is the *Pericardium*, which is placed next the *black Meconium*, or all that which is comprehended in the Rhomboidal Figure. I don't know whether the lower Part of it may not be the *Bladder*. But from the *Meconium* certainly riſes the *Rectum*, which aſcending above the *Pericardium*, is continued to the internal *Branchiæ*, and connected to the *Central Muſcle*.

The *Central Muſcle* is orbicular, white and ſmooth in a great Part of its Surface, where it adheres to the *Shell*; but on the left Side, it is diſtinguiſhed by another lacerated Muſcle, and is moulded more to the Shell.

Explication of Figures. *Fig.* 231. *a a a*, *The Mouth, and Head.* *b b*, The *Meconium* very black. *c*, The *Heart*, as it lies under the Membrane. *d d*, The *Pericardium*, the *Rhomboidal* Part of it perhaps the *Bladder*. *e e e e e*, The *Rectum* climbing over the *Pericardium*. *f f f f f*, The great *Central Muſcle*. *g g*, Another *lacerated Muſcle* adhering firmly to the *Shell*. *h h h h*, The internal *Branchiæ*. *i i*, The Termination of the *long Uterus*, marked with two *Foramina* as in *Hermaphrodites*. *k k*, the upper Part of the *Uterus*, *whitiſh*. *l l l*, Its lower Part, of a Saffron-Colour. *m m m m m*, The *variegated Border*, or *ſecond Net-like Muſcle*.

A ſort of Cockles in Eaſt-India; *by M* Witzen, *n.* 293. *p.* 870. *Fig.* 232. LXVII. There are found on the Coaſts of *Calabar* and *Ceylon*, certain Cockles or Shells, in *Dutch* call'd *Kouk-horens*. Theſe Shells contain a Fiſh that lives in the bottom of the Sea, fixt in the Body of the Shell, and at a certain Seaſon of the Year, they caſt their Seed, which produces a ſort of *Matrix* of the ſize of the Figure. The long Body which is wrinkled like an *Andouille*, or *Sauſage*, is fill'd with a great Number of round Cells, which are ſo many *Matrices*, each producing its little *Shell-fiſh*; which quit not their Cells till they are grown to ſuch a Bigneſs and Maturity, as their Weight breaks them off, and looſens them from their Cells, and ſo from their common *Matrix*, which remains faſtened to the bottom of the Sea by the great End, the other End moving about freely in the Water, which is flexible every way like an *Andouille*. It is obſervable that this *Matrix* has a kind of Back-part and Belly; the Back is ſomewhat like that of a *Sckelvis*, and of a grayiſh Colour, the Belly is whiter, and is that Part which is fill'd with the Cells from one end to the other: The Skin which covers it, is very like that of *Stock-fiſh* or other dried Fiſh.

Stones in the heads of Craw-fiſhes; by Mr. Ch. King, *n.* 206. *p.* 672.

LXVIII. The Stones in the Heads of *Craw-fiſh* are always on the outſide of the Stomach, while the Old Coat ſticks to the back of the Fiſh, and paſs into the Stomach as ſoon as they caſt their Coats; I never ſaw them on the outſide when they have changed, nor within before.

I have obſerved that the Males of *Craw-fiſh* change their Coats a conſiderable time before the Females; for they always keep theirs till they have parted with their Young from their Tails.

Carcelli, *or* Soldiers, *by Mr.* Will. Cole, *n.* 178. *p.* 1284. *Vide ſupra* §. LIX.

LXIX. Thoſe who ſhall ſeek after the *Purple-fiſh* will find, as I have done, ſome of thoſe Shells in which are the *Cancellarii*, or rather *Aſtaci*, unto which they are more like, and ſo may miſtake: For thoſe little Crabs, or Craw-fiſhes, I have found in moſt of our *Engliſh* Shells, excepting the *Bivalved*, and *Patella*'s. Of theſe Fiſhes in many Parts (eſpecially in the *Weſt-Indies*,) there are many ſorts, and ſome very large, which our Country-men there call the *Soldiers*; for that they ſay, they enter by force, kill and take Poſſeſſion of thoſe Houſes they have not built; and when they grow too big, forſake them and enter into larger. Whether that be true, I know not; but this I have found, when I have broken ſome of the Shells in which thoſe *Vagrants* are, ſo as not to bruiſe their Bodies, and then put them naked into the Water, I have beheld them with nimble ſpringing Motion, to run too and fro till they find a Stone to hide themſelves under; which not finding, they bury themſelves in looſe Sand. This Obſervation gave me full ſatisfaction, that they were not, (at leaſt all the kinds) *Connate* and *Coaleſcent* with their Shells; as other *Teſtaceous* Animals of the Sea and Land are.

A Stellar-*Fiſh, by Mr.* Winthorp, *n.* 57. *p.* 1151. *n.* 74. *p.* 2221.

Fig. 233.

LXX. 1. I underſtand by the Fiſherman who brought me this Fiſh, that he never ſaw, nor heard of any but ſix or ſeven that were taken at ſeveral times by himſelf, not far from the Shoals of *Nantucket* (which is an Iſland upon the Coaſt of *New-England*) when he was fiſhing for *Cod*. This *Stellar-fiſh*, when it was alive, and firſt pulled out of the Water, was like a Baſket, and had gathered it ſelf round like a Wicker-Baſket, having taken firſt hold upon the Bait on the Hook which he had ſunk down to the bottom to catch other

Fiſh, and having held that within the ſurrounding *Brachia*, would not let it go, tho' drawn up into the Veſſel; until by lying a while on the Deck, it felt the want of its Natural Element, and then voluntarily it extended it ſelf into a flat round Form. The only uſe that can be diſcerned of all that curious Compoſure wherewith Nature had adorned it, ſeems to be, to make it a Purſe-net to catch ſome other Fiſh, or any other thing, fit for its Food; and as a Baſket of Store to keep ſome of it for future ſupply; or as a Receptacle to prepare and defend the young ones of the ſame kind from Fiſh of Prey, if not to feed on them alſo (which appears probable the one or the other;) for that ſometimes there were found pieces of a *Mackarel* within that Concave; and he told me, that once he caught one, which had within the Hollow of its Embracements a very ſmall Fiſh of the ſame Kind, together with ſome piece or pieces of another Fiſh, which was judged to be of a *Mackarel*.

He told me, that every one of the ſmalleſt Parts had Motion when it was alive, and a tenacious Strength; but after it was dead and extended to a flat Round, it was ſo brittle that it could not be handled without breaking ſome Parts of it; but by carefully laying it to dry, it was ſomewhat hardned. I think (till a fitter *Engliſh* Name may be found for it) that it may be call'd a *Baſket-Fiſh*, or a *Purſe-Net-Fiſh*.

Ib ——, n. 374. p. 1153. 2. This elaborate Piece of Nature, we may call *Piſcis Echino Stellaris Viſciformis*, its Body (as was noted by Mr. *Hook*) reſembling an *Echinus*, or *Egg-fiſh*, the main Branches, a Star, and the dividing of the Branches, the Plant

Fig. 233. *Miſſeltoe*. This Fiſh ſpreads its ſelf from a Pentagonal Root, which encompaſſeth the Mouth (being in the middle, at *a*) into 5 main Limbs, or Branches; each of which, juſt at the iſſuing out from the Body, ſubdivides its ſelf into two (as at *i*,) and each of thoſe ten Branches does again (at 2,) divide into two parts, making 20 leſſer Branches: Each of which again at (3,) divide into two ſmaller Branches, making in all forty. Thoſe again (at 4,) into 80; and thoſe (at 5,) into 160; and they (at 6,) into 320. They (at 7,) into 640; at 8, into 1280; at 9, into 2560; at 10, into 5120; at 11, into 10240; at 12, into 20480; at 13, into 40960; at 14, into 81920; beyond which the farther Expanding of the Fiſh could not be certainly traced, though poſſibly each of thoſe 81920 ſmall Sprouts or Threads, in which the Branches of this Fiſh ſeem'd to terminate, might, if it could have been examined when living, have been found to ſubdivide yet farther. The Branches between the Joints were not equally of a length, though for the moſt part pretty near; but thoſe Branches, which were on that ſide of the Joint, on which the precedent Joint was placed, were always about a fourth, or fifth part longer than thoſe on the other ſide. Every of theſe Branchings ſeem'd to have, from the very Mouth of the ſmalleſt Twigs or Threads, in which it ended, a double Chain or Rank of Pores, as appears by the Figure. The Body of the Fiſh was on the other ſide, and ſeemed to have been protuberant, much like an *Echinus*, or *Egg-fiſh*, or *Button-fiſh*, and like that divided into five Ribs or Ridges, and each of theſe ſeemed to be kept out by two ſmall bony Ribs. *NS.* In the Figure is repreſented fully and at length, but one of the main Branches, whence 'tis eaſy to imagine the reſt cut off at the fourth ſubdividing Branch; which was done to avoid Confuſion.

3. This *Star-fiſh* is the *Stella Arboreſcens Rondeletii*; firſt deſcribed by him, and ſince by other Naturaliſts.

By Mr. Fra. Willoughby n. 58. p. 1200.

A Scolopendra Marina *by Dr.* Tho. Molineux. n. 225. p. 405.

Fig. 234, 235.

LXXI. 1. In *Decemb.* 1696, Two remarkable, Marine Animals were found in the Stomach of a common *Cod-fiſh* ſold in the Fiſh-Market in *Dublin.* One of them by lying long in the Stomach was much mangled and in part digeſted: But the other was compleat in all its Parts, and had received no manner of Alteration, ſave 'twas dead. It was bigger at one End, and went taper or gradually leſſening towards the other. It was four Inches and ſix tenths long; and where largeſt, as it was one Inch and one tenth broad, ſo it was about three Inches and a half in Circumference: At the ſmaller End, not above four tenths of an Inch broad. It hath neither Shells, Cruſt, Scales, or Bone, for its Covering, but was ſoft: Yet not Flabby or Fleſhy, as the μαλακία, or *Mollia*, but rather Membranous.

Fig. 234.

The Back or upper ſide, was ſhaped roundiſh, eſpecially towards the ſides; in the middle it was ſomething flattened; the Belly was perfectly plain. Along the middle of the Back ran a large Stripe from one extream to the other about two tenths of an Inch broad, towards the upper End, but ſtill narrower as it came towards the Tail. This *Stripe* was all covered with a ſhort ſoft ſort of Down, not unlike in Texture, Colour, and Subſtance, to that which grows on the Back of the Leaf of *Tuſſilago* or *Colts-foot.* Joining to the Edge of this *Stripe* ran from one to t'other, a Liſt about two tenths of an Inch broad, that covered both ſides of the Animal, and part of his Back. This Liſt or Verge, was thickly ſhagged, with a fine ſoft Hair that was very thick, and about a quarter of an Inch long, of a moſt delicate changeable red and green Colour, and of ſo ſparkling and vivid Luſtre, that nothing of this kind could ſhew more Beautiful. Among this ſoft Hair were thickly interſperſed without order, an abundance (ſome Hundreds I believe) of black, ſharp, hard Prickles, about the Length of the Hair, and the thickneſs of a Hog's Briſtle, but much harder, and very ſharp at the Points. The Tail, or ſmaller end terminated in the Back, with two Triangular pellucid ſoft Scales that covered the Orifice of the *Anus,* at which its Excrement was diſcharged, as I found when I opened it, for the Extremity of the Inteſtine was cloſely inſerted into this Paſſage.

Fig. 235.

The bigger end, though it had not any Horns, Eyes, Ears, Noſe, or Gills, yet becauſe it was oppoſite to the Tail, and here was the Mouth, we may properly enough call the Head. The Mouth was a very large patulous Opening for the Bulk of the Animal; not placed at the end, but ſomewhat underneath, as part of the Belly, and could not be ſeen when the Back was turned uppermoſt. The Belly was flat, and no ways protuberant, covered with a ſmooth naked Skin, of a much lighter Colour than the Back, irregularly ſpotted, with little dark browniſh Spots, ſome larger, ſome ſmaller:

'Twas broader towards the Head and grew narrower ſtill towards the Tail; where for above the ſpace of an Inch, it was curiouſly pinched with little Indentures, reſembling the ſmall Joints in the Tail of ſome Inſects. Theſe Diviſions, or Joints, were ſtill ſhorter and cloſer to one another, the nigher they were to the Extremity of the Tail. Beginning cloſe at each Corner of the Mouth, and ſo along both ſides of the Belly, was ranged a Row of Feet, in a cloſe continued Series down to the utmoſt tip of the Tail. The largeſt were placed towards the Mouth, and upper Part of the Body, where they were about a quarter of an Inch long, but downwards they grew leſs and ſhorter, ſtill gradually diminiſhing, the nearer they approached the end of the Tail; where they were ſo minute, that they were inſenſibly loſt, and not eaſily to be diſtinguiſhed by the Eye. I diſtinctly counted from the Mouth to the Tail, on one ſide 36, and I could not be poſitive but there might be ſtill more. From within the Body, thro' the middle of each Foot paſt four, five, or ſix, of the ſame ſort of ſharp hard Prickles, that were interſpers'd amongſt the ſoft Hair. Theſe were larger or ſmaller, or more or leſs in Number, according to the ſize of the Foot, and give it ſtrength and firmneſs inſtead of Bones: And likewiſe iſſuing forth beyond the end of the Foot ſerves in lieu of Toes, or Claws. Joining to this Row of Feet, towards the Back, was ranged along each ſide in a direct Line, a Series of ſmall thin, ſoft, flat Fins, Face to Face in ſuch an Order, that each Foot was exactly anſwered by its correſpondent Fin; ſo that their Number was preciſely the ſame with that of the Feet, and they kept the ſame Rule of Proportion of their Size, ſtill gradually diminiſhing the nearer they approached towards the Tail. I diſtinctly counted of theſe, as of the Feet, thirty-ſix of a ſide; each Fin was curiouſly fringed at the Edge, with the ſame beautifully-coloured Hair, I before mentioned to have covered the Sides and part of the Back. By help of theſe Fins is performed Progreſſive Motion through the Water as a Fiſh; and by means of the Feet could creep along the bottom of the Sea, as a *Reptile*.

When I open'd it, I found a thin membranous Gullet, that led from the Mouth to the Stomach, about an Inch long. From this was continued ſtraight downwards, the Stomach, of a whitiſh Colour, and of a tough thick Texture, conſiſting of an outward and inward Membrane, with a ſort of Carneous Subſtance between, reſembling ſomewhat in Make, tho' not in Figure, the Gizard in ſome Fowl; 'twas as large as the upper Joint of a Man's little Finger. To this was annext the Inteſtine, of a very differing Colour and Subſtance from the Stomach; for 'twas reddiſh, ſoft and tender, and of a much ſmaller Cavity; 'twas continued almoſt directly, or with little Circumvolution, to the *Anus*. The Brains, Heart, Gills, Liver, or Parts for Generation, (if they have any) were hardly, if at all, to be diſtinguiſhed.

The Muſcular Parts were very curious, large and diſtinct. One long continued Stripe of red fleſhy Fibres, about the ſixth Part of an Inch broad, ran directly along the middle of the Back, from the Head down to the Tail.

This fleſhy Stripe ſent out from each ſide, like ſo many Rays, thirty-ſix ſeveral pair of ſmaller lateral Muſcles, which, by the conſiderable Interſtice between, I could eaſily diſtinguiſh from each other; making ſo regular a Figure all together, that they might very aptly be reſembled to the Spine, or Backbone, of the *Paſſer Marinus*, or common *Plais-fiſh*, when it is entire with all its Ribs, or tranſverſe Proceſſes iſſuing by Pairs from both ſides of each *Vertebræ*, from the Head down to the Tail. In this manner every particular Foot and Fin were ſupplied with their correſpondent Muſcles, to give them Motion, either together or apart, as the Neceſſity or Deſign of the Animal required. And moreover, conſidering this ſort of Muſcular Mechaniſm, with the taper ſhape of the Body, and likewiſe the Poſture and uſe of the many Prickles interſperſed among the Hairy Shag that covered the ſides; it ſeems very evident to me, that beſides its Progreſſive Motion, it had alſo the Power, (as have moſt of the many-footed Land Reptiles, and ſome Water-Inſects I have obſerved) of Contracting its Body in ſuch a way, that bending its Head inwards, it roll'd the reſt of the Body round it as a Center, making a Figure like a Rope coil'd into a *Helix*; and in this Poſture, beſet almoſt quite round with ſharp Prickles ſtarting out directly forward, it guarded it ſelf from Violences that might annoy it.

This Animal, on many Accounts, I think, may be properly ranged with the *Scolopendræ Marinæ* deſcribed by *Rondeletius*; but it may be diſtinguiſh'd from them, by calling it *Scolopendra Marina à Capite Latiori verſùs Caudam ſenſim gracileſcens, Limbo Pulcherrimè Hirſuto Spinuliſque crebris interſtincto è Mari Hibernico.*

aaaaa. The Downy Liſt that runs along the Back; *b b.* the two Triangular Scales that cover the *Anus*; *cccccccc.* the Verge of fine changeable Green and Red Hair that covered the ſides, and part of the Back; *ddddddd.* the hard ſharp Prickles interſperſed among the Hair; *eeeee.* the Skin of the Belly; *ffff.* ſeveral Inciſures reſembling Joints towards the Tail; *ggggg.* darker Spots in the Skin of the Belly; *hhhhh.* the Feet of each ſide the Belly; *IIIIII.* the Fins with their hairy Fringe behind the Feet; *k k.* the large Mouth opened wide.

Explication of Figures, 234, *and* 235.

2. I obſerved at *Harwich* in 1698, divers of the Marine Animals brought up by the Fiſhermen, which they call *Sea-Mice.* They are deſcribed by *Rondeletius*, and by *Moufet* and *Johnſon* (Figured under the Title of *Phyſalus*) but badly.

By Mr. Dale, *n.* 254. *p.* 51.

3. I think, if we'll ſuppoſe that *Rondeletius* ſaw what he deſcribes under the Title of *Phyſalus*, we can't imagine that He and I had the ſame Object before us. This will appear evident by comparing his Words with mine: For he ſays of his Animal; *Ore caret*; whereas I ſay, the Mouth of mine was a *very large Patulous Opening for the Bulk of the Animal:* He ſays, *In Medio latior eſt & extrema gracileſcunt, Pudendi Muliebris ſpeciem referens*; whereas I ſay, *'Twas bigger at one end, and went taper, or gradually leſſening, towards the other:* He ſays, *In Dorſo tumores parvi eminent, Verrucas Piſcatores noſtri vocant*; I am ſure I could obſerve none ſuch, but ſay, *The*

By Dr. Molyneux, *n.* 251. *p.* 127. *de Piſcibus*, L. 15. p. 425.

Back was covered with a ſhort ſoft ſort of Down, in Colour, Texture, and Subſtance like that which grows on the Leaf of Tuſſilago: *Venenatum experti ſumus,* ſays he; whereas I found two of the *Scolopendra*'s I deſcribed in the Stomach of an Animal that had devoured them, and digeſted one as its Natural Food and Suſtenance; from whence we may conclude that they are not Poiſonous; and beſides *Rondeletius* his *Icon* agrees exactly with his own Deſcription; whereas it neither agrees with my Deſcription, nor my Figure.

Vol. 3. p. 87. But I have lately, in the *Acta Med. & Phil. Hafn.* of *Tho. Bartholine,* met with the Figure of a Sea-Inſect under the Name of *Vermis Aureus vel Species Erucæ Marinæ rarior,* which I am confident is the ſame with mine; tho' *Bartholine*'s Figure is faulty, and the Deſcription ſhort, falſe and imperfect.

De Inſect. L. 5. Cap. 15. And I am apt to think that *Ulyſſes Aldrovandus* deſign'd our *Scolopendra* by the *Scolopendra Marina Lato Corpore Subcaſtaneo velut Pedibus innumeris longiuſculis Aurei Coloris*; though his *Icon* be much worſe than *Bartholine*'s, and requires ſome Strength of Phancy, to gueſs whether it be really ſo or not.

A Way of catching Carps; by Mr J. Templer. *n. 95. p. 6066.*

LXXII. At Sir *Juſt. Iſham*'s, I lately ſaw four very large *Carps* that a Boy took with his Hands in the Heat of the Day: His way was this, he waded into the Pond, and then returning to the Sides, he would grope them out in the Sedge or Weeds, and tickling them with his Fingers under the Belly, quickly removed his Fingers to the Gills, and threw them out upon the Land; and this he did not in a narrow, but large Pond, of about an Acre of Ground. He knows when he is upon the *Carps Layer,* (if I may uſe that Term,) by the warmth of the Water, and then he immediately repairs to the Sides to purſue his Game.

I may here note, that *Carps,* and I ſuppoſe all other Fiſh that keep near the Bottom, keep always in a Shoal. And when they move from one place to another, they raiſe the Mud in the Heat of the Day; ſo that you may eaſily obſerve, what Road they travel, by a muddy Tincture near the bottom of the Water; and that ſo certainly, as you cannot eaſily miſs of covering the greateſt part of them with a *Caſt-net.*

Eels diſcovered plentifully in Froſts in Somerſetſhire *by Dr.* J. Bale, *n.* 18. *p.* 323.

LXXIII. From *Lamport* towards *Bridgewater, Eels* are ſo cheap in the Froſts of Winter, that they vend them for little. Their Abundance is from hence, that as People walk in the Froſty Mornings, on the Banks of the River, they diſcern towards the edges of the Banks, ſome Parts not hoar, as the reſt, but green; where ſearching the Holes of the Banks, they find heaps of *Eels.*

Two very large Eels, by Mr. Dale, *n.* 238. *p.* 90.

LXXIV. I have lately met with Relations of two very large *Eels,* caught upon the Coaſt of *Eſſex*; they both had all the Characteriſing Notes of the *Eel,* and wanted thoſe Barbles which the *Eel* ſometimes hath not, but the

Conger is never without. The firſt was taken ſomewhere about *Crickſea*? Its Length from the Tip of the Noſe to the Tail's end, was five Foot eight Inches; and in Circumference it was twenty-two Inches. The other was taken in *Malden*-Channel, about a Mile below the Town; the length of which was ſeven Foot; the Circumference twenty-ſeven Inches, the Weight thirty-ſix Pound, and out of its Belly was taken five Pounds of Fat; its Skin was black, and being ſtuft, is ſtill preſerved at *Malden*. The Fiſh was ſuppoſed to have been brought down thither by the great Floods, at the breaking of the laſt Froſt, becauſe of a Hurt it had on its Back, which the Fiſherman who caught it, told me he did conjecture might be from ſome Mill it muſt paſs through.

The Generation of Eels, *by Mr.* Benj. Allen. *n.* 231. *p.* 664.

LXXV. 1. The Reaſon of the Difficulty of diſcovering the manner of the Generation of *Eels*, is the different way of Generation, and that they breed in *February*, a time when few are taken but what are preſerved in Trunks or Ponds, where they breed not. This I examined two Years ſince, in ſome taken at a Mill, in which Holes they breed, eſpecially near gravelly Shallows; and found one with Egg, another with ſix young ones, in the great Inteſtine, which I call the *ſtrait Bowel* that deſcends immediately from the *Pylorus*, until the Winding begins. They were faſtned to very ſmall *Placentæ* each, which was fixed to the Inteſtine; the *Meſeraicks* at that time were very turgid. The Eggs were on the Outſide of the Inteſtine. It is certainly viviparous and feeds not, at leaſt groſs in the Winter; during all which, they lie ſtill till they have diſcharged their Young. The Parts diſtinguiſhing the Sex are diſcoverable; thoſe of the Male affix to the Extremity of the Kidney; the Female had a ſlender Gland tranſverſly lying near the Bowel; but of this I dare not ſay much.

In *Salt Water-Eels*, I have not found the like, though ſearch'd for; becauſe I am of Opinion, they do not breed, but are the ſame with the Freſh Water ones, ſince ſuch Multitudes of Freſh Water Eels go down to the Sea, and cannot return, yet are never taken at Sea, among the many brought hither; and there are *Veſtigia* of their Beards in the Freſh Water Ones.

By Mr. Dale, *n.* 238. *p.* 92.

2. That the Generation of any Animal cannot be Equivocal or Spontaneous but from animal Parents, hath been ſo well by many undeniable Arguments aſſerted, and by multiply'd Experiments confirmed, by thoſe famous and celebrated *Virtuoſi*, *Malpighius*, *Redi*, *Swammerdam*, *Leewenhoeck*, Mr. *Ray*, and others, that I think there is no Room to doubt but that *Eels* have the ſame Original: But it is much diſputed amongſt the Learned Naturaliſts whether *Eels* have diſtinct Sex, or are Hermaphrodite. Mr. *Allen* affirms, the Parts diſtinguiſhing the Sex to be diſcoverable; but Mr. *Leewenhoeck* could never find any ſuch thing; for all thoſe that he hath diſſected, he declares, were provided with an *Uterus*; from hence he doth conjecture

them to be Hermaphrodites, and beſides the *Uterus*, to be provided with Maſculine Seed.

Another Controverſy about the Generations of *Eels* is, whether they are Oviparous or Viviparous.

I find many ingenious Perſons, who firmly believe them to be Oviparous; but their Sentiments are contrary to the Obſervations of *Walter Chetwynd*, Eſq; who in the Month of *May*, found them to be Viviparous, by cutting open the red Fundaments of the Females, from whence the young *Eels* would iſſue forth alive.

And although Mr. *Allen* affirms them to be certainly Viviparous, yet his Obſervations concerning the Place of their Conception, I cannot conceive to be conſonant to that Care and Induſtry of Nature, in providing convenient Receptacles for preſerving the *Fœtus*; neither is it agreeable to Reaſon to believe, that when Nature hath provided an *Uterus* in all Animals, not only the Viviparous, and ſuch as only cheriſh the *Embryo in Utero*, but in the Oviparous alſo and Inſects, the *Eel* and *Xiphia*, or *Sword-fiſh*, ſhould be the only Animals without it; much leſs that the Guts, appointed by Nature, for the Secretion of Nouriſhment, and the Expulſion of the *Fæces*, and are always in Motion, ſhould be the Place of Generation in any Animals, though we may allow Eels not to feed groſs in the Winter. On the contrary, that the Eel hath an *Uterus*, is aſſerted by Mr. *Leewenhoeck*, who never found them without; which perhaps is that Part which Mr. *Allen* names a ſlender Gland, tranſverſly lying near the Bowel.

Beſides, Nature having in all Animals, Oviparous as well as Viviparous, hitherto diſſected, provided not only an *Uterus*, but alſo *Tubes* (firſt obſerved by *Fallopius*) for the conveying the *Ovum* from the *Ovarium* to the *Uterus*, another great Difficulty and Objection lieth againſt Mr. *Allen*'s Obſervations; and in which indeed he ſeems to contradict himſelf; for whereas he ſaith, that in one Eel he found Eggs, and thoſe on the outſide of the Inteſtine, but in the other, ſix young Ones, each faſtened to a ſmall *Placenta*, and thoſe within the great Inteſtine, how and by what Paſſages could thoſe Eggs come into the great Inteſtine; to be formed and invigorated, unleſs we may ſuppoſe they do, like the *Embryo*'s of ſome ſort of Inſects, which for the Conveniency of Food eat their own way into their heterogeneous, or aſſumed *Matrices*.

Obſervations on the Anatomy of a Porpus; by Mr. J. Ray. n.74.p.2220 n.76.p.2274

LXXXVI. In *April* 1669, at *Weſt-Cheſter*, I met with a young *Porpus*, caught upon thoſe Sands. The length was three Foot ſeven Inches; a ſtring of two Feet and two Inches, girded him in the thickeſt place; the ſhape of his Body was not much unlike that of a *Tunny-fiſh*, only his Snout longer and ſharper; his Skin was thin, ſmooth, and without Scales; in an old and well grown Fiſh, it's like the Skin may be thick and tough, as *Rondeletius* repreſents it. His Fins are cartilaginous, and flexible, not ſharp or prickly, as the Ancients report them. On his Back he hath only one, which was diſtant from the tip of his

Snout one Foot and nine Inches, and the Baſis of it is in length five Inches and a half; ſo that meaſuring from the tip of his Snout to the end of his Tail, it was ſituate ſomewhat below the Middle of the Fiſh's length. On the Belly it had only one pair of Fins nine Inches and a half diſtant from the tip of the lower Mandible, much about the Place where the foremoſt pair of Fins in other Fiſhes uſually grow. The Tail is forked, of the Figure of a Creſcent, the Breadth thereof from Angle to Angle 11 inches; and the Plain of it lies parallel to the Horizon, as in all others, I ſuppoſe, of the Cetaceous Kind; the Reaſon whereof I conceive to be partly to ſupply the uſe of the hindmoſt pair of Fins in other Fiſhes, which ſerve to balance the Body, and keep it up in the Water; and partly to facilitate the Fiſh's Aſcent to the top of the Water, to which he can immediately raiſe himſelf by a light Jerk of his Tail, thus placed for the uſe of Reſpiration, which is neceſſary for him.

For doubtleſs, if violently detained under Water, he would in a ſhort time be ſuffocated or drowned. Immediately under the Skin lay the Fat, which, as I remember, our Seamen call the *Blubber*; it was firm, full of Fibres, and in this ſmall Fiſh of an Inch Thickneſs, encompaſſing and encloſing the whole Body, Back, Belly and Sides. The Uſe whereof I conceived to be, 1. To keep the cold Water at a Diſtance from the Blood, which is, I believe, actually and to the Touch hot. 2. To keep in the hot Steams of the Blood from evaporating, by that means alſo preſerving and maintaining its natural Heat. 3. Perhaps alſo, to lighten or counterpoiſe the Body of the Fiſh, which would otherwiſe be too heavy to move and ſwim in the Water. Under the *Blubber* lay the muſculous Fleſh like to that of *Quadrupeds*, but of a darker Colour.

The Body was divided into three Regions, or *Ventres*, like a Quadruped, *viz.* Head, Breaſt, and Belly. The Veſſels and *Viſcera* in each *Venter*, for the main the ſame as in *Quadrupeds*; the *Abdomen* was encompaſſed about with a ſtrong *Peritonæum*; the *Guts* joined to the *Meſentery*, and of a very great Length, by Meaſure 48 Foot, without any Difference or Diſtinction of great and ſmall, neither was there any Blind Gut, or *Appendix*, that I could find; the Stomach was of a ſtrange Make, being divided into two large Bags, beſide other ſmall ones; I found nothing in it, but a good Number of thoſe little long Fiſhes, which our Fiſhermen dig out of the *Sands* at Low-water, and therefore called in ſome Places Sand-Eels; by ſome they are called *Launces*, and by *Geſner*, *Ammodytæ*. The Liver was of a moderate Size, ſituate in the Right-ſide, and divided into two Lobes, having no *Ciſtis Pellea*, or Receptacle of Gall annexed. The *Pancreas* large, ſticking cloſe to the third Bag of the *Stomach*, into which alſo its *Ductus* enters, and empties it ſelf. The Spleen was ſmall and roundiſh: The Kidneys large, ſticking cloſe to the Back, and lying contiguous one to the other, made up of many little Kernels, like to, but much leſſer than thoſe of an Ox, of a flat Figure, having no *Pelvis* in the Middle, but the *Ureters* going out at the lower End. The *Urine-bladder* was oblong, and little for the bulk of the Animal, having on each ſide a round Ligament, made of the umbilical Arteries degenerating: The *Penis* long, ſlender, having a ſmall ſharp *Glans*; it appears not outwardly, but lies hid in its *Sheath* within the Body, doubled up, or rather reflected, in the Form of the Letter *S.* as is that of a Bull. The Teſticles lie within the *Cavity* of the *Abdomen* on each ſide, as they do in an *Hedge-hog*, and ſome other Quadrupeds, of an oblong Figure; for their internal Subſtance, ſeminal Veſſels, both *Præparantia* and *Deferentia*, *Epididymides*, *Vas Pyramidale*, *Corpus Varicoſum*, and *Glandulæ Proſtatæ*, exactly like to thoſe of Quadrupeds. The ſeminal Veſſels perforate the *Urethra* with many little Holes, whereof four are moſt conſpicuous, ſomewhat above the Neck of the Bladder.

It had ſix ſhort Ribs that had no Cartilages, and ſeven that had Cartilages, on each ſide, I mean. The Breaſt-bone was very ſmall; the Diaphragm was Muſculous, as in Quadrupeds. The Heart large, included in a *Pericardium*, had its two Ventricles, Arteries and Veins; in a Word, the whole Structure and Subſtance of the Heart and Lungs agreed exactly with that of Quadrupeds. The Wind-pipe was very ſhort, as it muſt needs be, the Fiſh having no Neck, the *Larynx* at top was of a ſingular Figure, running out with a long Neck, and a Nob at the End like an old-faſhioned *Ewer*.

The Pipe in the Head, through which this kind of Fiſh draw their Breath, and ſpout out the Water, lies before the Brain, and ends outwardly in one common Hole, but inwardly it's divided by a *bony Septum*, as it were, into two Noſtrils; but below again it opens into the Mouth in one Hole. This lower Orifice is furniſhed with a ſtrong Spincter, whereby it may be ſhut and opened at Pleaſure, and above this Sphincter the ſides of the Pipe are lined with a glandulous Fleſh, which if you preſs, you will ſee ſtart out of the many little Holes, or *Papillæ*, into the Cavity of the Pipe, a certain glutinous Liquor. Above the Noſtrils is a ſtrong Valve or Membrane, like an *Epiglottis*, which ſerves to ſtop the Pipe, that no Water get in there againſt the Fiſh's Will. Within the *Fiſtula* are ſix blind Holes, having no Outlet; four tending toward the Snout, two above the Valve that ſtops the Noſtrils, and two beneath it, and two tending towards the Brain, having a long but narrow Cavity for the uſe of Smelling, as I conjecture; tho' opening the Brain, I could find neither Olfactory Nerves, nor *Proceſſus Mammillares*.

The Eyes are ſmall, conſidering the bigneſs of the Fiſh, and ſituate at a good Diſtance from the *Baſis* of the Brain; the Snout is long, and furniſhed with very large Muſcles to root or turn up the Sand at the bottom of the Sea for to find Fiſhes, as appears in that we found nothing in his Stomach but Sand-Eels, which, as was intimated before, lie buried in the Sand. The Brain and *Cerebellum* are, for the Subſtance and *Anfractus* of them, the ſame with thoſe of *Quadrupeds*, only differing in the Figure, as being ſhorter; but what they want in Length, they make up in Breadth. They have alſo the like Teguments called *Dura* and *Pia Mater*; ſix or ſeven pair of Nerves, beſides the Optick; the ſame Ventricles, only in the *Medulla oblongata* we obſerved not thoſe Protuberances call'd *Nates* and *Teſtes*. The Skull (*Cranium*) is not ſo ſtrong and thick as in *Quadrupeds*; but articulated after the ſame

Manner to the firſt *Vertebra* of the Back-bone. This largeneſs of the Brain, and Correſpondence of it to that of Man, argue this Creature to be of more than ordinary Wit and Capacity; and make to ſeem leſs fabulous and improbable thoſe ancient Stories related by *Herodotus*, *Pliny* the Elder, and *Pliny* the Younger.

In each Jaw it had forty-eight Teeth, ſtanding in a Row like to little blunt Pegs, the Tongue was flat, above an equal Breadth to the very tip, which was Toothed or Pectinated about the edges, tied firmly down to the bottom of the Mouth all along the middle, as *Ariſtotle* truly ſaith.

Whence I cannot but wonder that *Rondeletius* ſhould herein contradict *Ariſtotle*, and affirm, (contrary to Truth, as I believe) *quod Delphinis Lingua eſt mobilis, quæ modo exeri modo condi poteſt*; unleſs perchance in this Particular the *Dolphin* differs from the *Porpus*. For the *Porpus* is, as I take it, the *Phocæna* of the Ancients, which is a leſſer ſort of *Dolphin*, and not the *Delphinus*; at leaſt if the Fiſh we are deſcribing were a *Porpus*; for the Teeth of this Fiſh were leſſer than, and of a different Figure from thoſe in the Jaw of the *Dolphin* we got beyond Seas, yet is the Difference not great between the *Dolphin* and *Phocæna*. As for that Fiſh, which our Seamen now a-days call the *Dolphin*, and which, as it is deſcribed by Mr. *Terry* and *Ligon*, hath Teeth on its Tongue, ſmall Scales, is Finn'd like a Rock, of a pleaſant Smell and Taſte; what it is I know not, but I am ſure it is *toto Genere* different from the *Dolphin* of the Ancients.

We obſerved not in this Fiſh any Noſtrils, beſides thoſe in the *Fiſtula*, nor any Ear-holes or *Meatus Auditorii* at all; wherein alſo *Ariſtotle* agreeth with us, which yet *Rondeletius* found out near the Eyes. But we obſerved in the Skull a Bone, anſwering to the *Os Petroſum*, which moſt certainly was the uſe of Hearing.

As for the ſame *Porpus*, I agree with *Geſner*, that it was ſo called, *Quaſi Porcus Piſcis*, moſt Nations calling this Fiſh *Porcus marinus*, or the *Sea-ſwine*. Indeed it reſembles a Swine in many Particulars, as the Fat, the Strength of the Snout, *&c.*

LXXVII. In diſſecting a *Porpus*, which had been dead at leaſt three Days, I happened to wound the Inſide of my Finger very gently; but it did not bleed, being only a ſlight Scratch of a Tooth. I felt no bad Effects from it for four Days afterwards; and then it began to ſwell near the Joint, and have a bluiſh Caſt. The Swelling and livid Colour increaſed every Day, ſo that in four Days more it had run over two Fingers, and at laſt a third was beginning to be infected. I uſed a great many Things which I was adviſed to by Surgeons, but to very little Purpoſe; for now my Hand was ſeized, and the Pain got up to my Wriſt; but the firſt Thing that ſtopt its Progreſs, was the following Fomentation. *Take of Frog-Spawn-Water, ſix Ounces, of Armenian Bole half an Ounce, of white Vitriol four Ounces, mix them.* This was applied warm twice a-Day. Sometimes this was made Uſe of. *Take of burnt white Vitriol and Armenian Bole, of each four Ounces, of Camphire*

A venomous ſcratch with the Tooth of a Porpus, *by* Dr M. Liſter, *n.* 233. *p.* 726.

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an Ounce, of common Water eight Pounds, mix them and make a Collyrium. Then by applying an Anodyne Linament, and a Plaiſter of Bole and Diapalma over it, I got well at laſt of this unuſual and accidental Complaint. But beſides the livid Colour, which ſufficiently indicated a Poiſon, a very troubleſome and diſagreeable Itching, or a Kind of burning tormented me Day and Night, and the Searf Skin came all off from the Parts that were affected. As to the Fingers, they did not recover their former Strength for ſome Months.

Poiſonous Fiſh about the Bahama-Iſlands, *by M.* J. L. *n.* 114. *p.* 313.

LXXVIII. The Fiſh that are here, (at *New-Providence* one of the *Bahama-Iſlands*) are many of them Poiſonous, bringing a great Pain on their Joints, who eat them, which continues ſo for ſome ſhort time, and at laſt with two or three Days Itching the Pain is rubb'd off. Thoſe of the ſame Species, Size, Shape, Colour and Taſte, are one of them Poiſon, the other not in the leaſt hurtful; and thoſe that are, are ſo only to ſome of the Company; the Diſtemper to Men never, that we hear of, proves Mortal. Dogs and Cats ſometimes eat their laſt. In Men that have once had that Diſeaſe, upon the firſt eating of Fiſh, though it be thoſe that are wholſome, the Poiſonous Ferment in their Body is revived thereby, and their Pain increaſed.

Whales and Whale Fiſhing about Bermudas, *by*—, *n.* 1. *p.* 11.

LXXIX. 1. An underſtanding and hardy *Seaman* gives this Account of the *Whale-Fiſhing* about the *Bermudas*; that tho' many Attempts of Maſtering the Whales of thoſe Seas had been unſucceſsful, by reaſon of the extraordinary Fierceneſs and Swiftneſs of theſe monſtrous Animals; yet the Enterprize was lately renewed; and fit Perſons having been out at Sea 17 times, and faſtened their Weapons a Dozen of times, they kill'd in theſe Expeditions, two old *Female Whales*, and three *Cubs*, whereof one of the old ones, from the Head to the Extremity of the Tail was 88 Foot in length, by Meaſure, its Tail being 23 Foot broad, the ſwimming Fin 26 Foot long, and the Gills three Foot long, having great Bends underneath from the Noſe to the Navel, upon her after-Part, a Fin on the Back, being within paved (this was the plain Seaman's Phraſe) with Fat like the Cawl of a Hog. The other old one, he ſaid, was ſome 60 Foot long: Of the *Cubs*, one was 33, the other two much about 25 or 26 Foot long. The Shape of the Fiſh, he ſaid, was very ſharp behind, like the Ridge of a Houſe; the Head pretty bluff, and full of Bumps on both ſides, the Back perfectly black, and the Belly white.

Their Celerity and Force he affirmed to be wonderful, inſomuch that one of theſe Creatures which he ſtruck himſelf, towed the Boat wherein he was, after him, for the ſpace of ſix or ſeven Leagues in three quarters of an Hour's time. Being wounded, he ſaith, they make a hideous Roaring, at which all of that kind that are within Hearing, come towards that Place where the Animal is, yet without ſtriking or doing any Harm to the wary. He is of Opinion, that this Fiſh comes neareſt to that ſort of Whales which they call the *Tubertes*; they are without Teeth, and longer than the *Greenland-Whales*, but not ſo thick. That they fed much upon Graſs growing at the bottom of the Sea, was ſeen by cutting up the great Bag or Maw, wherein he had found in one of them about two or three Hogſheads of a greeniſh graſſy Matter.

The largeſt ſort of theſe Whales might afford ſeven or eight Tuns of Oil, if well huſbanded; the *Cubs* yield but little, and that is but a kind of Jelly. That which the old ones render, doth candy like *Pork's Greaſe*, yet burneth very well. He obſerved that the Oil of the *Blubber* is as clear and fair as any Whey; but that which is boil'd out of the Lean interlarded, becomes as hard as Tallow, ſpattering in the Burning; and that which is made of the Cawl reſembleth *Hog's Greaſe*. He affirms, that though this Greaſe be boiling, yet one may run one's Hand into it without ſcalding; to which he adds, that it hath a very healing Virtue for Cuttings, Lameneſs, *&c.* the Part affected being anointed therewith.

The time of Catching theſe Fiſhes is from the Beginning of *March* to the End of *May*; after which time they appear no more in that Part of the Sea, but retire, as it is thought, into the Weed-beds of the Gulph of *Florida*, it having been obſerved, that upon their Fins and Tails, they have Store of *Clams* or *Barnacles*, upon which the ſaid *Rock-weed* or *Sea-Tangle* did grow, a Hand long; many of them have been taken off them, of the Bigneſs of great Oiſter-Shells.

The ſame Perſon ſaith, that ſince his former account there hath been taken by order of the *Bermudas-Company*, 16 of thoſe Whales, the Oil whereof, to the Quantity of 50 or 60 Tuns, arrived in *Ireland* ſome few Months ago. n. 8. p. 132.

He adds, that about two Years ſince, there ſtranded upon the Coaſt of *New-England*, a dead Whale of that ſort which they call *Trumpo*, having Teeth reſembling thoſe of a Mill, and its Mouth at a good diſtance from, and under the Noſe or Trunk, and ſeveral Boxes or Partitions in the Noſe, like thoſe of the Tails in *Lobſters*, and that being opened, there run out of it a thin Oily Subſtance, which would candy in time; after which the Remainder being a thick fatty Subſtance, was taken out of the ſame Part with a Scoop. And this Subſtance he affirmed to be the *Sperma Ceti*; adding further, that the *Blubber*, as they call it, it ſelf, of the ſame ſort of Whales, when ſtewed, yields on the top a Creamy Subſtance, which taken off, and thrown upon White Wine, lets fall a dirty Heterogeneous Sediment, but what remains aloft, affords a *Sperma-Ceti-like* Matter.

He concludes his Relation with obſerving, that theſe Whales were to be met with between the Coaſt of *New-England* and *New-Netherland*, where they might be caught eight or nine Months in the Year; whereas thoſe about the *Bermudas* are to be found there only in the Months of *February*, *March*, and *April*.

Concerning the Death of the Whale, which hath been related to have ſtranded upon *New-England*, it is not very improbable but that it may have been kill'd by a certain *Horny-Fiſh*, which is ſaid by Mr. *Terrey*, in his *Eaſt-India Voyage*, to run his Horn into the *Whale's* Belly; and which is known ſometimes to run his Horn into Ships, perhaps taking them for *Whales*, and there ſnapping it aſunder, as happened not long ſince to an *Engliſh* Veſſel in the *Weſt-Indian* Seas.

3. Within theſe two or three Years in the Spring-time, and fair Weather, they take ſometimes, one, two or three *Whales* in a Day. They are leſs, I hear, than thoſe in *Greenland*, but more quick and lively; ſo that if they be ſtruck in deep Water, they preſently make into the Deep with ſuch Violence, that the Boat is in Danger to be haled down after them, if they cut not the Rope in time; therefore they uſually ſtrike them in Shoal-Water. They have here very good Boats for that Purpoſe, Mann'd with ſix Oars; ſuch as they can row forwards or backwards, as Occaſion requireth. They row gently to the Whale, and ſo he will ſcarcely ſhun them; and when the *Harpineer*, ſtanding ready fitted, ſees his Opportunity, he ſtrikes his *Harping-Iron* into the *Whale* about or before the Fins, rather toward the Tail. Now the *Harping-Irons* are like thoſe which are uſual in *England* in ſtriking *Porpus's*; but of ſingular good Metal, that will not break, but wind, as they ſay, about a Man's Hand. To the *Harping-Iron* is made faſt a ſtrong Lythe Rope, and into the Socket of that Iron is put a Staff, which when the *Whale* is ſtruck, comes out of the Socket, and ſo when the Whale is ſomething quiet, they hale him up by the Rope, and it may be, ſtrike into him another *Harping-Iron*, or lance him with Lances in Staves till they have kill'd him. I do not hear that they have found any *Sperma Ceti* in any of theſe *Whales*; but I have heard from credible Perſons, that there is a kind of ſuch as have the *Sperma* at *Eleutheria*, and others of the *Bahama*-Iſlands (where alſo they find often Quantities of *Ambergreaſe*;) and that thoſe have great Teeth (which ours have not,) and are very Sinewy. One of this Iſland of *Bermudas* (*John Perinchief*) found one there dead, driven upon an Iſland; and though I think, ignorant in the Buſineſs, yet got a great Quantity of *Sperma Ceti* out of it. It ſeems they have not ſo much Oil as ours; but the Oil, I hear, is at firſt, like *Sperma Ceti*, but they *clarify* it, I think, by Fire.

By Mr. Rich. Stafford. *n.* 40. *p.* 793.

4. We have in theſe Seas about *Bermudas* great ſtore of Whales, which in *March*, *April* and *May*, uſe our Coaſt. I have myſelf killed many of them. Their Females have abundance of Milk, which their young ones ſuck out of the Teats, that grow by their Navel. They have no Teeth, but feed on Moſs, growing on the Rocks at the bottom, during theſe three Months, and at no other Seaſon of the Year. When that is conſumed and gone, the Whales go away alſo. Theſe we kill for their Oil: But there have been *Sperma Ceti-Whales*, driven on the Shore, which *Sperma* (as they call it) lies all over the Bodies of thoſe Whales. Theſe have diverſe Teeth, which may be about as big as a Man's Wriſt.

I have been at the *Bahama*-Iſlands, and there have found of the ſame ſort of Whales dead on the Shore, with a *Sperma* all over their Bodies, but I could never hear of any of that ſort that were killed by any Man; ſuch is their Fierceneſs and Swiftneſs. One ſuch Whale would be worth many hundred

Pounds. They are ſtrong, and inlaid with Sinews all over their body, which may be drawn out thirty fathom long.

The Uſe of Air-Bladders in Fiſhes; by . . . . n. 114. p. 320.

LXXX. 1. I conjecture that Fiſhes, by reaſon of the Bladder of Air that is within them, can ſuſtain or keep themſelves in any Depth of Water: for the Air in that Bladder being more or leſs compreſſed, according to the Depth the Fiſh ſwims at, takes up more or leſs ſpace; and conſequently the Body of the Fiſh, part of whoſe bulk the Bladder is, is greater or leſs according to the ſeveral Depths, and yet retains the ſame Weight. Now the Rule *de Inſidentibus Humido*, is, that a Body that is heavier than ſo much Water, as is equal in Quantity to the Bulk of it, will ſink; a Body that is lighter will ſwim; a Body of equal Weight will reſt in any Part of the Water. By this Rule if the Fiſh in the middle Region of the Water, be of equal Weight with the Water that is commenſurate to the Bulk of it, the Fiſh will reſt there without any Tendency upwards or downwards: And if the Fiſh be deeper in the Water, the Bulk of the Fiſh becoming leſs by the Compreſſion of the Bladder, and yet retaining the ſame Weight, it will ſink, and reſt at the bottom: And on the other ſide, if the fiſh be higher than the middle Region, the Air dilating itſelf, and the Bulk of the Fiſh conſequently increaſing, but not the Weight, the Fiſh will riſe upwards, and reſt at the Top of the Water.

Perhaps the Fiſh by ſome Action can emit Air out of his Bladder, and afterwards out of its Body; and alſo, when there is not enough, take in Air, and convey it to this Bladder; and then it will not be wondred, that there ſhould be always a fit Proportion of Air in the Bodies of all Fiſhes, to ſerve their Uſe according to the Depth of Water they are bred and live in: Perhaps by ſome Muſcle the Fiſh can contract this Bladder beyond the Preſſure of the Weight of Water. Perhaps the Fiſh can by its Sides, or ſome other Defence, keep off the Preſſure of the Water, and give the Air leave to dilate it ſelf. In theſe Caſes the Fiſh will be helped in all intermediate Diſtances, and may riſe or ſink from any Region of the Water without moving one Fin.

By Mr. Boyle ib, p. 311.

2. To determine whether a Fiſh doth riſe or ſink in Water by Conſtricting or Expanding himſelf; take a Bolt-head with a wide Neck, and having filled it almoſt full with Water, put into it ſome live Fiſh of a convenient Size; that is, the biggeſt that can be got in, as a *Roche*, *Perch*, or the like; and then draw out the Neck of the Bolt-head as ſlender as you can, and fill that alſo with Water. Then obſerve the Motion of the Fiſh, and if upon his *ſinking* you perceive the *Water* at the ſlender Top does ſubſide, you may infer, he contracts himſelf; and if upon his riſing, the Water be alſo raiſed, you may conclude, he dilates himſelf.

By Mr. Ray, n. 115. p. 349.

3. I think that —— hath hit upon the true uſe the *Swimming-Bladder* of Fiſhes. For 1. It hath been obſerved, that if the *Swimming-Bladder* of a Fiſh be pricked or broken, ſuch a Fiſh ſinks preſently to the Bottom, and can neither ſupport nor raiſe up it ſelf in the Water. 2. Flat-fiſhes, as *Soles*, *Plaiſe*, &c. which lie always groveling at the bottom, have no *ſwimming*

ming Bladders that I could ever find. 3. In moſt Fiſhes there is a manifeſt Channel leading from the *Gullet*, or upper Orifice of the Stomach, to the ſaid Bladder, which without doubt ſerves for conveying Air thereunto: But there is a Valve, or ſome other Contrivance to hinder the Egreſs of it, ſo that you ſhall ſooner break the Bladder than force any Air out by this Channel. Yet in *Sturgeons*, Mr. *Willoughby* hath obſerved, that preſſing the Bladder, the Stomach preſently ſwelled: So that it ſeems in that Fiſh the Air paſſes freely both ways.

I verily think there is in the Coat of this Bladder a Muſculous Power to contract it when the Fiſh liſts: For, in many Fiſhes it is very thick and opake, like the Coat of an Artery (which hath, as Dr. *Willis* obſerves, ſuch a Muſcular Faculty) as for Example, in all the Cod-kind; in ſome, *v.g.* the *Hake*, call'd in Latin *Merlucius*, it is inwardly covered with a Red Carneous Subſtance, which I take to be Muſculous Fleſh; in others it is forked at the Top, and to each Horn hath a Muſcle affixed. Now the Muſculous Force need not be great, being ſtill aſſiſted by the Water, as the Fiſh deſcends; the Preſſure of the Water being much greater at the Bottom, than at the Top.

The Power alſo of dilating the *Abdomen* by the Muſcles, aſſiſts thoſe Fiſhes to riſe, whoſe natural Place is towards the bottom: And the Air compreſſed in the Bladder dilating it ſelf as the Fiſh aſcends, facilitates that Action of the Muſcles. But thoſe Fiſhes that deſcend by contracting the Bladder, letting the *contracting Muſcle* ceaſe to act, will riſe again of their own Accord, the Air within dilating it ſelf; as we ſee in Glaſs-Bubbles, by Compreſſion of the Air in them deſcending, which as ſoon as the Force is removed, aſcend without more ado.

Beſides the flat Fiſhes I before mentioned, all the Cartilaginous Kind, as well flat as long, want Swimming Bladders: What Courſe they uſe to aſcend and deſcend in the Water, I know not. Many of the Eel-kind (not all) have Swimming-Bladders, yet can they hardly raiſe themſelves in the Water, by reaſon of the length and weight of their Tails: I ſuppoſe, the Air-Bladder being near their Heads, helps them to lift up their Head and Fore-part.

The Eyes of Fiſh, by Dr. Allen Moulen, *n.* 199. *p.* 716.

LXXXI. I have obſerved in the Eyes of Fiſh, that the *Proceſſus Ciliaris* is not faſten'd to the joining of the *Cornea* or *Sclerotis*, as in all other Animals that I diſſected, ſo as to hinder the Watery Humour to go any further backward. For I conſtantly obſerve, that the *Humor Aqueus* may move a good way backward in ſome, and in others almoſt as far as the Optick Nerves. And in as many Fiſh as I could conveniently examine carefully, I have found a Membrane which covered the *Tunica Cornea*, ſo as not to let any Water come to it. This anſwers the *Membrana Nictitans* in Fowl, and reaches on all ſides to the *Cutis* of the Fiſh to which it is faſtened. This is Tranſparent, and pretty Thin; and ſo is all the *Cornea*, if compared to that of *Quadrupeds*.

I have alſo obſerved that the Eyes of Fiſh, as well as thoſe of Fowl, are more or leſs Cartilaginous: For the *Scelerotis* is a *Cartilago ſui Generis*, eſpecially near the *Cornea*; and in the larger ſorts of them, I have found the whole *Scelerotis* ſuch a kind of a Cartilage.

The Structure of the Internal Parts of Fiſh, by Dr. Char. Preſton, n. 223. p. 419.

LXXXII. Fiſh are remarkably different from all other Animals in many particulars. The moſt conſiderable difference is their want of Lungs, and their not Breathing: And yet it is neceſſary that ſomething ſhould ſupply this in Fiſhes, which may have the ſame Effect upon their Blood, as the Air has upon ours, by entering into our Lungs, that is to ſay, to divide and diſſolve it, and render it fit for Circulation. Now we find no part in Fiſh more proper to produce this Effect than the *Bronchiæ*, that lie like ſo many Leaves upon each other under their Gills: For they receive the Water in by the Mouth, and return it by the Gills; or Receiving it in by the Gills, they throw it out by the Mouth. Hence it is agreed upon by all, that the Water contains ſomething that produces this Effect, and this ſeems moſt probably to be Air.

That there is Air in all Water cannot be doubted after this Experiment of M. *Marolle*. He ſet a Veſſel of Water over the Fire, ſo as to drive out the Air from it. This Water he put into the Air-Pump to draw out the Air from it; and after that fill'd a Vial with it, within two or three Fingers of the Top, which ſpace he left only full of Air, and ſtopt the Vial well; and by ſhaking it, the Water imbibed the Air, ſo as to riſe up and quite fill the Vial.

But we need not wonder that Fiſh cannot alſo live in the open Air. Their Blood is naturally leſs hot than ours, ſo that the natural Heat of ours would be a Fever in them, and mortal: For the *Nitre* of the pure Air is in too great a Quantity, and too ſubtile, ſo that it diſſolves their Blood too much, and makes it too Fluid, whereas the Nitre in the Water is more groſs and in leſſer Proportion; whence it gives their Blood only a Fluidity requiſite to keep it in its Natural State. To prove that it is in the *Bronchiæ* that this Diviſion is performed, we need but obſerve their Extraordinary Redneſs above any other part of the Body; a Proof that the Blood is there more divided. Fiſh are alſo found to die in Water frozen over, which happens plainly from their Communication with the outward Air being hindred by the Ice.

The Heart of Fiſh is different from that of other Animals in its having but one Ventricle: For it has only the *Vena Cava* and the *Aorta* that open into it, having no Lungs. So that by the *Aorta* the Blood comes out of the Heart, which is branched into a thouſand Capillaries over the *Bronchiæ*, and is after Re-united; which Re-union is made under the *Baſis* of the *Cranium*; and becauſe the Blood, when once there, has no need of being forced higher upwards, they have no occaſion for a ſecond Ventricle for that purpoſe, as Terreſtrial Animals have. The Re-union of theſe Capillaries of the *Bronchiæ* being made, they form two large Trunks, of which one proceeds towards the Head, and the other towards the lower Parts.

Fiſh have a *Diaphragm*; but not for the ſame Purpoſe as in other Animals that breathe. It is always ſtrait and tenſe, and perpendicular on the *Vertebræ*; it hinders the terminating Salts that exhale from the Inteſtines from coming to the Heart, which might cauſe ſome Alteration there.

Their Stomach is Membranous; for Fiſh ſwallow down other ſmaller Fiſh whole, and ſometimes Earth. Wherefore 'tis needful to have a Power of Contracting and Straitning it ſelf, forcibly to break to pieces the hard Matters contained therein. Their Inteſtines make ſeveral great Windings about; a Sign the Fermentation is but ſlow therein; which is made up by the length of the Inteſtines. The Liver has much the ſame Situation as in other Animals; as alſo the Spleen has. They are provided of a Gall-Bladder, a *Ductus Choledochus* and *Pancreas*, or rather two little Bags faſtened to the Ventricle for the ſame uſe. Fiſh have uſually many *Pancreas's* ſo that in ſome there have been told forty-four. They have Kidneys, Bladder, &c.

They have the *Ovary* near to the *Vertebræ* of the Loins. The Eggs come forth at a Paſſage below the *Anus*: And the Male has a like *Ductus*, or Hole, by which they eject their Seed upon that of the Female to impregnate the Eggs; which the Male ſometimes changes the Colour of, as he paſſes over them, when he caſts his Seed upon them after they are laid.

Fiſh have on the *Vertebræ* of the Loins a Bladder, very large in proportion to their Bulk; which ſerves, by compreſſing or dilating it ſelf, to render the Fiſh more or leſs heavy, as Occaſion requires. The Fins and Tail aſſiſt them in their Paſſage through the Water whither they will: But 'tis this Dilatation that makes them capable of ſwimming in it; and if this Bladder be by any means burſt, ſo that it cannot be extended, the Fiſh can no more raiſe it ſelf in the Water, but keeps continually at the Bottom. *Flat-fiſh*, ſuch as *Soles*, have none of this Bladder: For they are able, by Reaſon of their Breadth, to keep themſelves up in the Water. *Cray-fiſh*, and other *Shell-fiſh* want it likewiſe, for the moſt part; for they creep only at the Bottom of the Water. There are many Fiſh that have them double.

The Wild-Gooſe; by Dr. M. Liſter, n. 175. p. 1. 1160.

LXXXIII. There are commonly reckoned five different Kinds of Wild-Geeſe frequent enough in *Yorkſhire*, viz. 1. *The little Spaniſh-Gooſe*; as ſmall as a * *Barnacle*, but in Shape and Colour ſomewhat reſembling the *Tame-Gooſe*; it has its Name from *Spain*. 2. *The Barnacle*; well enough known. 3. *The* Scotch *Gooſe*, viz. the moſt common Kind of Wild-Gooſe, which comes to us from *Scotland* about the latter End of *Auguſt*, of which there are innumerable Flocks in the Plains called the *Woolds*, and are here and there found white. 4. *The Whilk*; *the largeſt black Gooſe*, feeding on Graſs; for the moſt part in Parks and Incloſures. 5. Our *Fen-Gooſe*, which is called the *Grey Lagg*, and is equal in Size to a Tame-Gooſe.

Its Head is a Browniſh-black, and the Neck duſky down to the Middle; the Back between an Aſh and a Blue Colour, and the Wings and Legs Blackiſh. The Tail is Whitiſh, and its external Feathers White, the Belly

* *Brenta*.

of an *Aſh-Colour*, growing gradually White towards the Middle. The *Bill* from the Head to the Middle is *black*, below that *purpliſh*, and the Tip of it *black*. In the upper Part of it there is only a Row of ſmall Teeth, and the ſame in the lower. The Tongue too is armed with a Row of little Teeth on each Side. The Feet are *purpliſh*, or of a *fleſhy Colour*, the Nails almoſt white, except that of the middle Toe, which is moſtly black. It weighs ſeven Pounds, and almoſt a Half. They build their Neſts in the Fens in *Yorkſhire*; and both they and their *Goſlings* grow fat in *May*, and are reckoned very good Eating.

But I will not affirm the *Grey Lagg* to be different from the common *Wild* Ib. p. 1161. *Gooſe*; Mr. *Ray*'s Deſcription and mine ſo well agree, ſave in the Colour of the *Bill* and *Legs*.

LXXXIV. In the Weſtern Iſlands of *Scotland*, the Weſt Ocean throws *The Barnacle, by Sir* Rob. Murray, *n.* 137. *p.* 925. upon their Shores great Quantities of very large Weather-beaten Timber; the moſt Ordinary Trees are *Firr* and *Aſh*. Being in the Iſland of *Eaſt*, I ſaw lying upon the Shore a Cut of a large Firr-Tree of about two Foot and a half Diameter, and nine or ten Foot long, which had lain ſo long out of the Water, that it was very dry, and moſt of the Shells that had formerly covered it, were worn or rubbed off. Only on the Parts that lay next the Ground, there ſtill hung Multitudes of little Shells: They were of the Colour and Conſiſtence of Muſcle-Shells. This *Barnacle-Shell* is thin about the Edges, and about half as thick as broad. Every one of the Shells hath ſome Croſs Seams, or Sutures, which, as I remember, divide it into five Parts, near about the manner as in the Figure. *Fig.* 236.

Theſe Parts are faſtened one to another, with ſuch a Film as Muſcle-Shells are.

Theſe Shells hung at the Tree by a Neck longer than the Shell, of a kind of a Filmy Subſtance, round and hollow, and creaſed, not unlike the *Wind-Pipe* of a *Chicken*, ſpreading out broadeſt where it is faſtened to the Tree; from which it ſeems to draw and convey the matter which ſerves for the Growth and Vegetation of the Shell and the little Bird within it.

In every Shell that I opened, I found a perfect Sea-Fowl; the little Bill like that of a *Gooſe*; the Eyes marked; the Head, Neck, Breaſt, Wings, Tail, and Feet, formed; the Feathers every where perfectly Shaped, and Blackiſh coloured; and the Feet like thoſe of other Water-Fowl, to my beſt Remembrance. The biggeſt I found upon the Tree, was but about the Size of the Figure; nor did I ever ſee any of the little Birds alive, nor met with any Body that did; only ſome credible Perſons have aſſured me that they have ſeen ſome as big as their *Fiſt*.

LXXXV. 1. The Bird which at *Paris* is called *Macreuſe*, and in other *The Scotch* Barnacle *and* French Macreuſe; *By Dr.* Tancred Robinſon, *n.* 172. *p.* 1026. parts of *France*, *Macroul*, the *French* eat upon Fiſh-Days, and all *Lent*, thinking it to be a ſort of Fiſh, or a Marine Animal with cold Blood, or elſe a *Barnacle* generated either out of rotten or corrupted Wood floating upon the *Sea*; or out of certain *Fruits* falling into the Water, and there Metamorphoſed into a Bird; or elſe from a kind of Sea-Shells, adhering to old Planks and Ship-Bottoms, called *Concha Anatifera*. But in truth theſe Shells contain a Teſtaceous Animal of their own Species, as the *Oiſter*, *Cockle*, and *Muſcle* do: Whereas the *Barnacle* is of the *Gooſe*, and the *Macreuſe* of the *Duck*-kind; and both Oviparous; the Truth of which is evident by the Anatomy of their Parts ſerving for Generation, and by their laying Eggs and ſometimes breeding among us.

The *Macreuſe* is the *Scoter*, or *Anas Niger Minor* deſcribed by Mr. *Ray*. It is frequently taken in Nets placed under Water upon the Coaſts of *Normandy* (moſt plentifully at the Mouth of the *Sein*) *Languedock* and *Provence*; and I am confident, I have ſeen it upon the *Laguna* of *Venice*, at the Mouths of the *Brenta*, *Atheſis*, and the *Po*. A *Duck* very like unto this (if not the ſame,) I alſo ſaw upon the *Mare Mortuum*, and the *Lake Avernus*.

The Macreuſe, by Mr. Ray, ib. p. 1042.

2. I had no ſooner ſeen the Caſes of the Male and Female *Macreuſe*, which Dr. *Robinſon* ſent me, but inſtantly I found it was no Stranger to me. There is a particular Deſcription of the *Cock* in Mr. *Willoughby*'s *Ornithology* among the *Sea-Ducks*, to which this Bird belongs, and not to the *Divers* or *Duckers*, M. *Graindorge*'s Deſcription I find upon attent reading to be very faithful: But notwithſtanding what he ſaith of the Debility of its Feet, unfit for Walking on Land, I ſee not but that it may march as well as the reſt of its kind, all which have but ſhort and weak Legs in Proportion to the bulk of their Bodies, and thoſe alſo ſituate very backwards.

What he ſaith of the Smallneſs and Weakneſs of the Wings, and Shortneſs of their Feathers, is common to many Sea-fowl, *viz.* the *Tridactylæ* and *Mergi*, which yet by the Nimble Agitation of them, fly very ſwiftly and ſtrongly.

Why they of the Church of *Rome* ſhould allow this Bird to be eaten in *Lent*, and upon other Faſting-Days, more than others of this Kind, but eſpecially the *Tridactylæ*, I ſee no Reaſon; the Fleſh of theſe laſt, which live only or chiefly by Preying upon Fiſh, properly ſo called, taſting ſtronger of Fiſh than the Duck-kind, which all feed, partly at leaſt, upon Shell-fiſh (as M. *Graindorge* found the *Macreuſe* alſo to do) and have a delicate and well-taſted Fleſh.

I obſerve in this Bird, and in ſome others of the Sea-Ducks that are much under Water, that they want that Veſſel, or *Ampulla*, ſituated in the very Angle of the Divarication of the Wind-Pipe, which for want of a better and fitter Name, we are wont to call the *Labyrinth* of the *Trachea*. We may very probably from hence conclude, that the *Labyrinth* doth not ſerve them for a Reſervatory of Air, to enable them to continue the longer under Water, as I ſometimes conjectured, but for the intending and modulating of the Voice, ſeeing in the *Plaſh-Duck* the Females want it: But I am ſomewhat to ſeek about the Uſe of this Veſſel. I obſerved it in the *Mergus Cirratus longiroſter major* or the *Dun-Diver*, and that very large, and extended by very ſtrong Bones, and yet I thought my ſelf to have ſufficient reaſon to judge that Bird to be the Female of the *Merganſer*: But I dare not be confident that it is the Female becauſe of the *Labyrinth*.

The Manner of Hatching Chickens at Cairo, by Mr. Jo. Graves, n.137.p.923

LXXXVI. In the Houſes built for this Uſe there is a long Entrance, *a b.* on each ſide of which are fourteen Ovens (ſome places have more, ſome leſs.) The bottoms and ſides of theſe Ovens which are on the Ground, are all made of Sun-dried Bricks, upon which they put Matts, and on the Matts, Eggs.

*Fig.*237 The top of theſe Ovens are flat, and covered with Sticks, except two long ſpaces which are made of Sun-dried Bricks; and are the Hearths, in which the Fires are made, to heat the Eggs lying under them in the lower Ovens.

Above theſe lower Ovens are ſo many other, made of Sun-dried Bricks, and Arched at the top: Where alſo there are ſome Holes, which are ſtopp'd with Tow, *&c.* or left open, as they pleaſe, to govern the Heat in the Ovens below. The upper Ovens are made after this manner.

*Fig.*238. *a.* The Mouth of the Oven, opening upon the long Entrance above mention'd, *b.* and *c.* Entrances into the Ovens adjoining, *d, e.* two Hearths three or four Inches deep, in which they make the Fire, to heat this and the Oven below. The depth of the lower Oven is about two Foot and a half *Engliſh*, the Second above four.

They begin in the midſt of *January* to heat the Ovens; ſpending every Morning 100 *Kintars* or 100 Pound Weight of *Camels*, or of *Buffalo*'s *Dung*, and the like Proportion at Night, till the midſt of *February*, about which time the Ovens are ſo hot, that one cannot well endure to lay his Hand upon the Walls.

After this, they put the Eggs into the Ovens to hatch the Chickens; which they continue ſucceſſively till the end of *May*.

The Eggs are firſt put upon Matts in the lower Ovens, which are upon the Ground, ſeven or eight thouſand Eggs in Number; and laid only double one upon another.

In the Ovens above theſe lower, the Fire is made in the long or little Channels, from whence the Heat is conveyed into the lower Ovens before-mentioned. The Eggs which are directly under theſe Hearths, lie treble one upon another; the reſt, as was ſaid, only double.

At Night when they new-make their Fires in the Hearths, above-mentioned, they then remove the Eggs that were directly undermoſt (lying three one upon another) in the place of thoſe which lay on the ſides, only double; and theſe being now removed, they lie treble under the Hearth, becauſe the Heat is greater there, than on the ſides.

Theſe Eggs continue in the lower Ovens fourteen Days and Nights: Afterwards they remove them into the upper Ovens; which are juſt over the lower. In theſe (there being now no more Fire uſed) they turn all the Eggs four times every twenty-four Hours.

The 21*ſt* or 22*d* Day the Chickens are hatched; which the firſt Day eat not; the ſecond, they are fetched away by Women, who give them Corn, *&c.*

The Maſter of the Ovens hath a third Part of the Eggs for his Coſt and Pains; out of which, he is to make ſuch good unto the Owners (who have two thirds in Chickens for their Eggs) if any happen to be ſpoiled or miſcarry.

The Fire in the upper Ovens, when the Eggs are placed in the lower, is thus proportioned:

The firſt Day the greateſt Fire, the ſecond leſs than the firſt, the fourth more than the third, the fifth leſs, the ſixth more than the fifth, the ſeventh leſs, the eighth more, the ninth without Fire, the tenth a little Fire in the Morning, the eleventh they ſhut all the Holes with Flax, *&c.* making no more Fire; for if they ſhould, the Eggs would break.

They take Care, that the Eggs be no hotter than the Eye of a Man, when they are laid upon it, can well endure.

When the Chickens are hatched, they put them into the lower Ovens, which were covered with Mats. Under the Mats is Bran to dry the Chicken; and upon the Mats Straw, for the Chicken to ſtand upon.

To breed up Pheaſants and Partridges, by Sir Edm. King, n. 23. p. 428.

LXXXVII. *Ants* are the principal Food of very young *Partridges* and *Pheaſants*, both wild and tam'd, for ſeveral *Weeks:* And a chief Reaſon, why many find it ſo nice a thing to breed up the ſaid Birds, is, that either they give them too ſparingly of this Food, or let them faſt too long; not knowing, that as ſoon as 'tis Day-light, they will ſeek it for their Breakfaſt, and if they want it, will in a few Hours be faint and weak, and ſome grow ſo Chill for want of that Supply of Nouriſhment, that it is no eaſy matter to recover them. But afterwards, when they are grown bigger, if by ill ordering of thoſe that ſhould keep them ſweet, and often ſhift their Water, or by ill Diet, or muſty Corn, *&c.* they become ſick, then *Ants* will not always recover them, tho' you give them never ſo many; and I have been forced to make uſe of other Inſects to cure them, as *Millepedes* and *Earwigs*; either of which will do good; but both together better, given in a good Quantity, and at leaſt two or three times a Day. But then thoſe other things muſt be obſerved too, of keeping their Houſe clean, and giving them ſweet Corn and ſhifting their Water twice a Day, keeping them within till the Dew be from the Ground, letting them baſk in the Sand, partly in the Sun, the Place being a little ſhaded, and putting them up in a warm Houſe before Sun-ſet.

Swallows *found in Lakes in Winter, by* M. J. Schefferus, n. 19. p. 350. *by* M. J. Hevelius, *ib.* p. 347.

LXXXVIII. 1. It is moſt certain that *Swallows* ſink themſelves towards Autumn into Lakes, no otherwiſe than *Frogs*; and many have aſſured me of it, who have ſeen them drawn up with a Net, together with Fiſhes, and put to the Fire, and thereby revived.

2. I have frequently heard Fiſhermen affirm, that they have here, about *Dantzick*, often fiſhed them out of the Lakes in the Winter, but I never have ſeen it my ſelf.

LXXXIX. The *Ortigometra*, or *Rail*, is a ſort of Fowl very numerous in all Parts of *Ireland* in its Seaſon; but that's but ſhort, and laſts not above three or four Months in the Summer; during all the remaining Parts of the Year, it lies buried in the Ground.

The Rail, *by Dr.* Tho. Molineux, *n.* 234. *p.* 747.

XC. That ſort of Bird mentioned by Dr. *Plot* to be often heard in *Wood-ſtock*-Park, (from the Noiſe it makes, commonly call'd the *Wood-cracker*,) is perhaps the leſſer ſort of *Picus Martius Varius*: For ſince the Publiſhing of Mr. *Willoughby*'s *Ornithology*, I have obſerved that Bird ſitting on the top of an *Oaken* Tree, making with her Bill ſuch a Cracking or Snapping Noiſe, as we heard a long way off; the ſeveral Snaps or Cracks ſucceeding one another with that extraordinary Swiftneſs, that we could not but wonder at it. But how ſhe made the Noiſe, whether by the nimble Agitation of her Bill too and fro in a Riſt of the Bough, or by the ſwift Striking of the Mandibles one againſt another, as the *Stork* doth, I could not clearly diſcern: ut an intelligent Gentleman, who was very diligent in obſerving the ſame Bird, ſaid it was the former way.

The Wood-Cracker, *by Mr.* Ray, *n.* 172. *p.* 1043.

XCI. I ſaw one or two little Birds which I hear are commonly called the *Silk Tail* by the Germans, ſhot at *York* the End of *January* 1680. It is a very beautiful little-Bird, almoſt of the Size of a Black-bird; at the Extremities of the Wings it has four or five ſmall, naked, horny Points, of a Saffron-Colour, not covered with Feathers, and the Extremity and Side of the Tail is of the Colour of Citron-Bark, the reſt of it is moſtly of the Colour of the *Lanii*.

But I have view'd the Bill of this kind of Bird at Mr. *Charlton*'s, and find it to want the Notches in the upper part of the Bill proper to the *Lanius-Kind*, it muſt therefore be put among the *Jaws*.

The Silk T:il, *by Dr.* M. Liſter, *n.* 175. *p.* 1161.

XCII. 1. I have ſent you the curiouſly contrived Neſt of a Humming Bird, ſo called from the humming Noiſe it maketh whilſt it flies. 'Tis an exceeding little Bird, and only ſeen in Summer, and moſtly in Gardens, flying from Flower to Flower, ſucking Honey out of the Flowers as a *Bee* doth; as it flieth, not lighting on the Flower, but hovering over it, ſucking with its long Bill a ſweet Subſtance. There are in the Neſt two of that Bird's Eggs; whether they uſe to have more at once I know not.

The Humming Bird, by Mr. Jo. Winthorp, *n.* 74. *p.* 2223.

2. Theſe Eggs were ſo ſmall, that being weigh'd by me, the one weighed but about five Grains, the other, three and a half: And the whole Neſt weighed no more than twenty-four Grains.

By Mr. Oldenburg, *ib.*

3. There is in moſt parts of *America*, a Bird call'd by the *Engliſh* the *Humming-Bird*, by the *Spaniards*, *Tomincius*. He is of a moſt excellent ſhining green Colour, and very reſplendent; the Colour doth ſomething reſemble ſome of our *Engliſh Drake's Heads*. It doth inhabit in ſome of the colder Parts of *America*, as well as in the hotter. It is the leaſt of all Birds that I have ſeen there or in *England*; her Leg and Foot together is but half an Inch, the other Parts anſwerable; the Trunk of her Body not an Inch. I did weigh one in thoſe Parts as ſoon as ever it was killed, whoſe weight was the 10th part of an Ounce *Avoirdupois*, which I take to be about the Weight of a coined

By Mr. Hamerſly, *n.* 200. *p.* 760. *n.* 202. *p.* 815.

Sixpence: And I have weighed here in *England*, a *Tit-Mouſe*, (which I take to be the leaſt Bird here) and it weighed above two Shillings, and ſome half a Crown. I ſaw one of their Neſts made of Cotton-Wool, in form and bigneſs of the Thumb of a Man's Glove, with the taper End ſet downwards, wherein were two Eggs of the bigneſs of a Pea, of an oval form. They feed by thruſting their Bill and Tongue into the Bloſſoms of Trees, and ſo ſuck the ſweet Juice of Honey from them; and when he ſucks, he ſits not, but bears up his Body with a hovering Motion of his Wings; but for the Relation that he is a curious Singing Bird, I think it untrue. An *Indian Soggamore* is not in his full Pomp and Bravery without one of theſe Birds in his Ear for a Pendant. He is called the *Hum-Bird* or *Humming Bird*; becauſe ſome ſay, he makes a Noiſe like a Spinning-Wheel when he flies: But I have been many times very near them, both when they hovered, and when they did fly, and I never heard any Noiſe; beſides, their Body and Wings are too ſmall to ſtrike Air enough to make any Noiſe. But of this I ſhall not be poſitive, becauſe ſome Authors are oppoſite to me. It is a ſolitary Bird; I never ſaw but two at a time together, *viz.* the Male and Female; they being eaſily known when together, the Male being ſomewat bigger than the Female.

If one take a Small Bird's Wing, and ſtand four or five Yards from a Candle (when dark) and open the Wing, and look thro' it at the Candle, he may ſee a moſt elegant Colour of Red and Green, which Green doth ſomething reſemble the Colour of this Bird.

By Dr. Neh. Grew, *n.* 202. *p.* 815.

4. Perhaps the *Tomincius* does not feed on any Juice he ſucks off, or out of Flowers, but rather (like many other Birds) on ſmall Inſects, ſome whereof lie in the bottom of moſt Flowers; and for which this Bird hath a Bill, whereas a Bird that ſucks hath a *Syphon* or hollow Probe.

Obſervations on the diſſection of a Paroquet, *by Mr.* R. Waller, *n.* 121. *p.* 153. *Hiſtory of* Braſil.

XCIII. There is a very great variety of Species in the *Parrot-kind*, whether we conſider the Country, Size or Colour. *Johnſton* ſays, the Curious have obſerved above an hundred ſorts of them. The ſixth Species of *Paroquets*, by *Margravius*, comes very near our Subject.

Its ſize is between a *Sparrow* and a *Black bird*, with a ſhort Neck, black Eyes, a crooked ſcarlet Bill, greyiſh Legs and Feet, with Toes two before and two behind, like the *Parrot*; yet he never ſtands on one Foot to eat with the other, as *Parrots* do. When he ſtands ſtill on the Perch, his Breaſt and Belly ſhew of a curious light green, his Back, and the Feathers of his Wings are ſomewhat darker; on his Pinions are ſome ſhort blue Feathers, as likewiſe a pretty many on his Rump. His Bill is encompaſſed up to the Eyes with a broad beautiful ſcarlet Circle, reaching alſo down to his Throat: This Place in the *Hen* is of a paler Orange-Colour, wherein is the only obſervable Difference. The Feathers of the Tail (which in all ſmall *Paroquets* is no longer than the Wings) are not to be ſeen but when he *flutters* or *ſpreads* it. They are about two Inches long, near the Quill, of a Limon-Colour, enclining to a Green; next a Scarlet for a pretty Breadth; then a narrow Thread of Green on ſome of them, after that a Black; and laſt of all ending in a light Green.

Having opened the *Thorax* and *Abdomen* (if I may ſo call them,) by blowing into the *Aſpera Arteria*, a large Cavity or Bladder was raiſed up all along the *Abdomen* to the Edges of the *Os Iſchion*, and faſten'd to the *Gizzard*, containing in it all the *Guts* and *Gizzard*, but excluding the Heart and Liver. A Conformation like this is obſerved in all Birds, and peculiar to them, and mentioned by M. *Perault*, the *Air* received by the Lungs refreſhing and carrying off the noxious Steams from the Entrails, is not confined, as in Men, and *Quadrupeds* to the *Thorax* only by a *Mediaſtinum*.

Mech. des Animaux.

The *Aſperia Arteria* differs from that of moſt other Animals, having not only a *Larynx* at the top thereof, as is uſual, but another alſo at its Entrance into the Breaſt, where it is divided, and branches it ſelf into two. From this Structure, as I have been told, common to all *Parrots*, poſſibly it may be that they can ſo readily imitate human Voices; but this Creature we Diſſected, never attempts an Imitation of Words, making only a ſhrill chirping Noiſe, doubling the Tone, or making it eight Notes lower, as a ſtopt Organ-Pipe is an Eighth to the ſame Open. This lower *Larynx* may aſſiſt the weak Fabrick of ſo ſmall a Creature as a *Parrot*, to counterfeit ſo Baſs a Voice as a Man's; it being obſerved by ſome ingenious Perſons, that *Parrots* are *Ventriloqui*; and that it may be Queried, whether all Ventriloquous Cheats may not by Nature be framed for ſuch an Impoſture.

The Heart in Proportion to the Animal, was large, and the Liver ſmall.

The Tongue was broad and thick, at the End ſomewhat like a Man's: whence a *Parrot* has its Name *ἀνθρωπόγλωττος*: The Extremity of it was armed with a Horny Cover.

It has, beſides the Gizzard, two *Craws*, the uppermoſt Craw being only a Receptacle or Sack for the Food (which is *Canary-Seed*) to be again committed to the Mouth of this Bird, where it is again chewed, having before been only huſked; this Animal ruminating as ſome Quadrupeds do; and I have obſerved this Bird, when upon the Perch, not only bring its Food again up into its Mouth, and there chew it, but when the Cock and Hen ſit together on the Perch, he will put out of his into the Hen's Mouth. Their manner of chewing is thus, the under Bill being much ſhorter, ſhuts within the upper, or againſt the Roof of the Mouth, which is fitted with ſeveral rows of very ſmall and ſcarce to be ſeen Croſs-bars, as the Mouths of Horſes, Dogs, and ſome other Animals are; theſe Bars are not ſoft, but horny, as being part of the upper Bill, ſo that the Bird by carrying the Edge of the under Bill and End of the Tongue againſt the Ridges in the upper, breaks and reduces to a Pap the Seeds that have been firſt moiſtened in the Craw; to expedite which Action, the upper Bill is joined juſt below the Eyes. The Food being thus macerated, is by the *Gula* again committed to the ſecond Craw; but before its Entrance into it, it paſſes by an abundance of ſmall Glands, placed in that part of the *Gula*, that the Food may ſqueeze out of them in its Paſſage a Juice; of what Neceſſity in Digeſtion may be required. From hence the Food paſſes into the Gizzard, or proper Ventricle, ſmall in Compariſon of the *Ingluvies* or Crop; where, by ſeveral Stones pickt out of the Sand given it, by the Motion of the Gizzard, it is comminuted, and thence tranſmitted to the Inteſtines, on the Sides of which, within a ſmall Diſtance is placed the *Pancreas.*

The Explication of the Figures.

*Fig.*240. *a.* The *Aſpera Arteria*; *b.* that part which forms, as it were, another *Larynx*; *c.* Part of the *Gula*; *d.* the upper *Craw*; *e.* the Heart; *ff.* the *Venæ exillares*; *gg.* the *Jugulars*; *h.* a ſmall *Gland* on one of them; *ii.* the two *Auricles* of the *Heart*; *kk.* the *Liver*; *l.* the *Gizzard.*

*Fig.*241. *a.* The *Trachea*; *bb.* the *Larynx*; by which Parrots are rendred *Ventriloqui*; *cc.* the two Branches of the *Trachea.*

*Fig.*242. *a. a.* The *Cornua* of the *Os Hyoides*; *b. b.* the two Muſcles of the *Larynx*; *c.* the Fiſſure, or *Glottis*; *d.* the *Trachea*; *e.* the *Tongue*; *f.* the Horny End thereof.

*Fig.*243. *a. a.* The *Teſtes*; *b. b.* the *Deferentia*; *c. c.* the Kidneys; *d. d.* the Ureters.

*Fig.*244. *a.* The Upper Part of the *Gula*; *b,* the firſt or upper Craw; *c.* that Part of the *Gula,* whoſe Inſide is Glandulous; *d.* the lower Craw; *e.* the Gizzard, or the Ventricle; *f.* the firſt *Inteſtine*; *g.g.* the *Pancreas.*

*Fig.*245. *a.* The upper Bill; *b.* the Inſide of it; *d. d.* the upper Jaw; *c.* the Place where the upper Bill is moveable; *e.* A Paſſage to the Noſtrils; *f.* the lower Bill; *g.* the upper Bill in another Poſture, to ſhew the ſmall Ridges therein.

XIV. The *Oſtridge* is eſteemed the largeſt and talleſt of winged or feathered Fowl, as being ſometimes eight Foot high: Which Bulk, if we compare with the *Tomine jo,* or *Hum-Bird,* weighing about twelve Grains, we may readily diſcern within what Compaſs and Latitude the Creation of Birds was ordained.

Obſervations on the Diſſection of an Oſtridge, *by Dr.* Edward Brown, *Ph. Coll. n.* 5. *p.* 147.

The whole Foot of this Bird, *à Calcaneo ad extremum Digitum,* is three quarters of a Yard; upon which he ſits when he reſts himſelf: But the Foot, properly ſo called, or longeſt Claw, is only a quarter, the leſſer Claw one eighth and half a Nail. The Nail upon the longeſt Claw is a Nail long: Above which ſtand one above another ſixty-three large Scales, reaching up along his Foot before, or before thoſe Bones which anſwer to the *Metatarſus.* The leſſer Claw hath no Nail, and only eight or nine Scales one above another, which reach no higher than the Claw it ſelf. The Grain of the Foot is like the Grain of the Skin of an *Elephant,* but not ſo very hard, and is moveable, and gives way upon Preſſure like the Foot of a *Camel*; there being Fat under it, whereby he treads ſoft, and without Noiſe: But higher than the two Claws the Skin looks Scaly. Every ſmall Scale conſtituting an irregular *Pentangle, Quadrangle,* and ſometimes *Hexangle.*

From the Heel to the Knee, or that Part of the Leg which anſwers to the *Tibia* in Man, it is five eighths of a Yard; the Thigh above a quarter, and very thick.

Upon the Breaſt there is a hard callous dark Subſtance, of an oval Figure, a Nail and a half in Length, like to that of a *Camel*, upon which he reſts himſelf when he ſits, with his Head upright; and in that Poſture I think he ſleeps, for we could never ſee him in any other. His Wing is too little to cover all his Neck. There is alſo a callous Part upon the *Os Pubis*, longer than the former-mentioned, but narrow; upon which, together with the callous Part upon his Breaſt, he reſts himſelf. The Length of his Body from the lower Part of the Neck to the End of the Rump, is one Yard; the longeſt Bone in his Wing is three eighths of a Yard, and his Neck a Yard, not meaſuring the Head with it.

The top of the Head is flat, in length three eighths of a Yard, meaſuring from behind the Head to the End of the Bill. It ſeems to be hairy rather than covered with Feathers; but the Neck hath beautiful white Feathers, contrary to what ſome affirm. On the top of his Head there is a flat oval Place, a Nail in length, which is all callous, and without any Hair, or Feathers, like the callous Part of his Breaſt, but not ſo thick, to preſerve the Brain from the *Serenes* that fall in hot Countries, and other Injuries of the Air, eſpecially in the Night, and the more conſiderably, if he ſleeps with his Head upright, and not under his Wing.

The *Gula* is very large, as well as long, but largeſt at the top near the Head: where it is a Nail and a half broad. The *Os Hyoides* ſtretcheth its ſelf down to each ſide of the Neck, the length of one Eighth of a Yard, and half a Nail.

Beſides the many Muſcles in the Neck, for the Motion of the numerous *Vertebræ* and the Head, there are two moſt elegant Muſcles, which come from within the *Thorax*, ariſing within the Cheſt about the ſecond Rib, which inſert themſelves on each ſide of the *Aſpera Arteria*; theſe I may name *Directores Aſperæ Arteriæ*. At the firſt dividing of the *Aſpera Arteria*, or its Divarication on every ſide of the Lungs, there is a Ring bigger and ſtronger than any other Ring of the Wind-Pipe. There are divers Glandules in the Neck near the *Gula*, theſe are of a pale Colour like Aſhes; but there are two moſt beautiful Glandules ſticking to the *Carotidal Arteries*, as they come out of the Breaſt, one on each ſide; theſe are bluiſh.

The *Peritonæum* doubles and encompaſſes the Stomach looſely. He hath ſeven Ribs, and the *Intercoſtal Muſcles* are broad, plain, and beautiful. He had no Prominent Breaſt-Bone, like other Fowls, nor a narrow Cheſt like many *Quadrupeds*, but a broad Breaſt, and a large firm *Sternon*, of the ſhape of a Shield, broader than the *Sternon* of a Man; and indeed when he puts down his Head, and bends his Neck round to come in at a Door, his Breaſt is ſo broad, and his Tread ſo different, that it is not at all like the Entrance of a Fowl, but wonderfully like that of a *Camel*; but with this Advantage, that the *Oſtridge* bearing his Weight upon two Legs only, his Entrance is more bold and graceful.

The *Penis* was about an Inch long, with a ſmall Cartilaginous Subſtance in it, the *Teſtes* lie very high, near the Kidneys and Back-bone, and were very ſmall and ſlender, of a yellow Colour.

The Ear is round, and the Orifice will receive one's Finger; the Eye is large and bluiſh, and almoſt as big as a Man's.

The natural Colours of the Feather of this Fowl were White, Grey and Dun; the Feathers of the inſide of the Wings, upon the Breaſt, and Belly, and Neck, were White, and the Feathers in the Tail alſo White, but the reſt are Greyiſh, or of a Dun Colour; yet it is a moſt beautiful Creature ſurely in *Barbary*, where the Heat of the Country criſps and curls all its Feathers.

The *Rimula* of the *Larynx* is long, and the Cartilages about it ſtrong, but no *Epiglottis*, or likeneſs to a Human *Larynx*, although they that heard its Voice, compare it to the crying or ſhrieking of a hoarſe Child, but more mournful and diſmal. The Lungs are of fine florid Colours, but little in Proportion to the vaſt *Aſpera Arteria*; they ſtick cloſe to the Back, and are perforated like other Birds: And upon blowing into the Wind Pipe with a Pair of Bellows, we could not make them riſe or fill. The Heart had two Ventricles, about the bigneſs of a Man's Heart; but the right Ventricle is much thinner, and the Valves are more fleſhy.

There are two Stomachs, as in Granivorous Fowls, a Crop and a Gizzard; but the Crop, or firſt Stomach, differs much from that of other Fowls, in that it is not placed without the *Breaſt*, but within the *Sternon*; in that it is not round, but longer, like a Bag, and of a vaſt Bigneſs, lying lengthwiſe in the Body. We found many Glandules in the Coats of this Stomach, a Row of them on the back Part of it, reaching almoſt from one End to the other, about a Thouſand of them, about ten in Breadth, and an Hundred in Length. Theſe lie between the Coats of the Stomach, and every particular Glandule diſcharges it ſelf by a peculiar Orifice, thro' the inward Coat of the Stomach into the Cavity thereof. We found ſome of theſe Glandules round and globular, ſome oval, and ſome more flat, and of an irregular Figure; thoſe which lie higheſt are roundeſt and thickeſt; thoſe which lie more towards the Bottom of the Stomach, or where it unites with the Gizzard, are more broad and flat. Theſe bring in a Juice which helps to digeſt that various Nouriſhment which the Fowl makes uſe of. The Gizzard was very large, the inner Coat did not adhere ſo firmly as in other Fowls, and was very thick and like Flannel, and upon our firſt looking into the Gizzard, from the firſt Stomach, it appeared as a Piece of Flannel or Napkin, which the *Oſtridge* had ſwallowed, and ſo ſtuck there. The Paſſage out of the Gizzard into the ſmall Guts is very ſtreight.

The Guts are about 20 Yards in Length, the ſmaller Guts beginning from the Stomach are ten Yards long, and the larger Guts down from thence to the *Anus*, are near as much. At the Beginning of the great Guts there are two *Inteſtina Cæca*, each of them a Yard long: And they have a Scrue or *Spiral Valve* within them, after the Manner of the *Cæcum* of a *Rabbit*; this Scrue in both in the *Inteſtina* winds about 20 Turns. The Extremity of the *Cæcum* is little, not much differing from the *Cæcum* of a Man. The Excrement, which is thrown out by the Guts, is of two Kinds, a white, thin, ſticking Excrement,

crement, which it mutes like a *Hawk*, and after that, another ſort of Excrement comes, which is very like to that of a Sheep, but bigger.

The *Meſentery*, although it holds together ſuch a Number of Guts, great and ſmall, yet it is not thick, but is only a tranſparent Membrane, as generally in *Pennates*; but it is very large, and in ſome Places above three Eighths of a Yard deep or broad, meaſuring from the Center to the Guts.

The Liver hath four Lobes, and is of a Colour not much different from that of a Man's; we could find no Bladder of Gall. There was a Glandule under the Stomach, which might ſeem to be a *Spleen*: But *Pennata* and *Inſecta* are ſaid to have no Spleens. The *Pancreas* was ſlender, and above a Foot long. The Kidneys are large, and of the length of my Hand; as they lie both together, they are of the Shape of a *Guitar*. The *Ureters* are firm, ſtrong, white, and long. Behind the Kidneys lie two Glandules, ſomewat oval, of about an Inch and half in length, cloſe to the Back-bone.

The Head reſembles that of a *Gooſe*, and is little in proportion to the whole Body.

In *Africa*, where ſome make Meat of *Elephants*, it is no Wonder if ſome alſo feed upon *Oſtridges*; but *Galen* and Phyſicians condemn it as hard of Digeſtion.

The Cuntur of Peru, by Dr H. Sloan, n. 208. p. 61.

XCV. The Magnitude aſcribed to the *Cuntur* or *Condor* of *Peru*, as well as its great Force and Strength, have been the Cauſe that many have doubted its Being. Capt. *John Strong*, Commander of a Ship which went into the *South-Seas*, through the *Streights* of *Magellan*, and returned after 23 Months Voyage, in the Year 1691, gives me this Account, together with the Wing or Quill-feather of the Bird; *viz.* That on the Coaſt of *Chili*, they had met with this Bird in about 33° *S. Lat.* not far from *Mocha*, an Iſland in the *South-Seas*, and before they came at a Place called *Herradura*, that his Men were very much amazed at the Bigneſs of it, and that after they had killed it, it was 16 Foot from Wing to Wing extended. The *Spaniſh* Inhabitants there told them, it was the *Cuntur*, and that they were afraid of theſe Birds, leſt they ſhould prey on, or injure their Children. The Feather he gave me is two Foot four Inches long, the Quill-part is five Inches three quarters long, and an Inch and half about in the largeſt Part, it weighed three Drams 17 Grains and half, and was of a dark brown Colour, very hollow or concave on one Side, and convex on the other. The Seamen ſhot it ſitting on a Cliff by the Sea-ſide, and eat it, taking it for a ſort of *Turkey*, in which Miſtake likewiſe, the firſt Comers to *Jamaica* were with a Bird in that Place, called a *Carrion-Crow*, which is a ſort of *Vulture*, of which kind, I believe this alſo is.

Obſervations on the Heads of Fowl; by Dr. All. Moulen, n. 199. p. 713.

XCVI. 1. In the Heads of all Fowl that I have had an Opportunity to examine, I conſtantly found only one *Aquæductus*, or Paſſage from the Ears into the Palate; whereas in Men, Quadrupeds, and ſome Amphibious Fiſh, there are always two. This Paſſage in Fowl is exactly in the middle of the

Palate, below the Entrance of the Noſtrils into it. It is a Membranous Tube, capable of admitting a *Raven*'s, if not a *Gooſe*-Quill in large Fowl, ſuch as *Turkeys*, *Geeſe*, &c. and reaches backwards as far as the *Communication* from Ear to Ear: And hence it comes to ſerve both, whereas there is a Neceſſity of two in thoſe Animals, whoſe Ears do not communicate.

2. I conſtantly found a hollow Space between the two Tables, between the *Os Cuneiforme* reaching from Ear to Ear, and as forward as the aforeſaid common *Aquæductus*, or rather *Ductus Aereus*, the Contrivance of it ſeeming more to favour this than the former Uſe. This Cavity in all Fowl (as far as I have obſerved) reaches above the *Labyrinthus* on each ſide; ſo that whatever Impulſe is made on the *Tympanum* on the one ſide, may not only be very readily communicated by Means of the Internal Air to the *Labyrinthus* of the ſame, but alſo to that of the oppoſite Side. Hence probably proceeds the Quickneſs of Hearing, and Vigilancy of Fowl, notwithſtanding their wanting a *Cochlea*; the Defect of which ſeems to be by this Structure more than ſupplied, no other Creatures that we know of having any Thing of it. There are ſeveral *Laminulæ*, and Pillars of hard Bone between the two Tables in theſe Cavities, deſigned, as may be ſuppoſed, partly for their Maintenance at a convenient Diſtance, and partly for breaking of the Air, ſo as to hinder Ecchoes, and confuſed Repreſentations of Objects, as it hath been ingeniouſly obſerved by Sir *J. Hoſkins*, That Pillars in Churches very much Ecchoe.

3. In the Heads of *Woodcocks*, beſide the Paſſages now deſcribed, I found one on each ſide the Bone, making the Orbit of the Eye, proceeding from the Ear, and reaching forwards towards the ſetting on of the Beak, near which they joined in one, and turned under the Skull in a ſmall Paſſage leading to the Cavity, by which the Ears communicate, and which is above deſcribed, into which it enters. Theſe Paſſages are alſo in the Heads of *Snites*, and moreover one over the *Sinus longitudinalis*, and another over the *Sinus lateralis* of the Brain. *Note*, That in the killing of *Snites*, and ſmaller Birds, if Care be not taken that the Head be not bruiſed, theſe Paſſages cannot be diſcovered for Blood extravaſated in them. *Note* alſo, That the *Laminulæ*, and Bony Pillars, are every where to be obſerved where there is a Paſſage, excepting under the Skull, in the Paſſage from the ſetting on of the Bill to the firſt Paſſage deſcribed.

4. In the Heads of *Parrots* and *Paroquets*, beſides the firſt deſcrib'd Paſſage, I obſerved, between the two Tables, every where Cells opening into others, and thoſe into others, ſo that there was not any Part ſcarcely of the Skull that was not taken up with them. And this did not only appear by pouring into one Ear, freed from its Drum, the other alſo being removed, a Tincture of *Cochineel*, and then blowing of it into all theſe Cells, ſo that no Part was free from Tincture, but it appeared alſo to the naked Eye, notwithſtanding that ſometimes it was difficult to trace the Communications of them, by Reaſon of the Numerouſneſs of the *Laminulæ*, and Pillars aforeſaid.

5. In Singing Birds, the Structure of theſe Paſſages is like that of the *Parrot* and *Paroquet*, only that the Pillars and *Laminulæ* are leſs than they ſhould

ſeem to be in Proportion to the Heads: From whence it is probable, that theſe Birds are by this Structure enabled to diſtinguiſh Sounds and Notes, and alſo imitate them better, having a more muſical Ear.

6. In the Heads of *Pullets*, *Geeſe*, and *Ducks*, I found only the firſt deſcribed Paſſage diſtinctly: But in *Plovers*, *Buſtards*, and ſome other, I found another that went over the *Sinus lateralis* of the Brain from Ear to Ear. This ſeems to be deſigned to make them more watchful than Domeſtick Fowls, or than thoſe that live much on the Water, becauſe they are liable to a great many Dangers that the others are exempt from.

7. In the Ears of all the Fowl that I could examine, I never found any more than one Bone and a Cartilage, making a Joint with it, that was eaſily moveable.

The Cartilage had generally an *Epiphyſe* or two on each Side, which were very flexible as it ſelf was. The Bone was ſmall and very hard, having at the End of it a broad Plate, of the ſame Subſtance, very thin, upon which it reſted as on its Baſis.

8. I obſerved three Pair of Nerves in all the Broad-bill'd Birds that I could meet with, and in all ſuch as feel for their Food out of their Sight, as *Snites*, *Woodcocks*, *Curlews*, *Geeſe*, *Ducks*, *Teals*, *Widgeons*, *&c.* Theſe Nerves are very large, equalling almoſt the *Optick Nerve* in Thickneſs; they begin a little more forward than the Auditory Nerve from a little Protuberance which ſeems to be made for them. One of them goes over the Optick Nerve in the Orbit of the Eyes; the other two go under the Eye; two are diſtributed nigh the End of the upper Bill, and are there very much expanded, paſſing through the Bone into the Membrane, lining the Roof of the *Mouth*: the third Pair is diſtributed near the End of the lower Bill, and ſubdivided like the former. *Note*, that Birds that pick their Food where they can ſee it, have not theſe Nerves, and that the Pair of Nerves belonging to the upper Bill, is conſiderably ſmaller in Proportion to the Fowls, than thoſe obſerv'd above; whence it is probable, that theſe Nerves are deſigned for ſome great uſe, both on the Account of their Number and their Largeneſs, and that the uſe to be aſſigned to them, muſt be to enable them to diſtinguiſh (whether by Taſting or Feeling, I will not now determine) their Food, there being a Neceſſity of a more exquiſite Senſe in theſe Fowl, than in any other. The 246 Figure repreſents thoſe in a *Duck's* Head, where *a a* expreſſes the Edge of the *Cranium*, which is in Part removed for the more clear View of theſe Nerves; *b b.* are the Cells about the Ear, between the two Tables above deſcribed; *c c.* the *Brain* laid bare, with its Blood-Veſſels; *d d d.* the three Nerves on one ſide; *e.* the Optick Nerve; *f f f.* the Skin and Part of the Bone removed, to bring the Nerves in View; *g g.* the two Nerves expanded near the End of the upper Bill; *h h.* that in the lower. *Fig.* 246.

9. All the Eyes of a Fowl and of Fiſh, that I have examined, were more or leſs cartilaginous; for the *Sclerotis* is a *Cartilago ſui generis*, eſpecially near the *Cornea*, in all theſe Animals. And in the larger ſort of both, I remember to have found the whole *Sclerotis* ſuch a Kind of a Cartilage.

10. I have frequently obſerved in ſmaller Fowl, that the Membrane of the *Drum* was double, for by gently pulling away the Membrane lining the *Tube* of the Ear, I have obſerved at the bottom of it a tranſparent Membrane; which at firſt I took to be the Membrane of the Drum, but upon Examination, I found that the Membrane of the Drum was ſtill entire, and in its proper Place. I have alſo ſometimes obſerved this in larger Fowl, in a *Seal*, and in ſome other Animals, and perhaps it may be ſo in all.

By Mr. J. Clayton, n. 206. p. 990. 2. Dr. *Moulen* and my ſelf, when we made our Anatomies together at *London*, ſhew'd to the *Royal Society*, that all flat-bill'd Birds, that Groped for their Meat, had three Pair of Nerves, that came down into their Bills; whereby, as we conceived, they had that Accuracy to diſtinguiſh what was proper for Food, and what to be rejected, by their Taſte, when they did not ſee it. This was moſt evident in a *Duck*'s Bill and Head, a *Duck* having larger Nerves that come into their Bills than *Geeſe*, or any other Bird that I have ſeen, and therefore *Quaffer* and *Grope* out their Meat the moſt. But I then diſcovered none of theſe Nerves in round bill'd Birds: But ſince in my Anatomies in the Country, in a *Rook* I firſt obſerved two Nerves, that came down betwixt the Eyes in the upper Bill; but conſiderably ſmaller than any of the three pair of Nerves, in the Bills of *Ducks*, but larger than the Nerves in any other round-bill'd Birds. And 'tis remarkable, theſe Birds more than any other round-bill'd Birds, ſeem to grope for their Meat in Cow-dung, and the like. Since I have found in ſeveral round-bill'd Birds, the like Nerves coming down betwixt the Eyes, but ſo very ſmall, that had I not firſt ſeen them in a *Rook*, I ſhould ſcarce have made the Diſcovery. In the lower Bill alſo there are Nerves that have much the ſame Situation with the flat-bill'd Birds, but very ſmall, and ſcarce diſcernable, unleſs to the cautious and curious.

Ib. p. 993. The Ears of Birds differ much from thoſe of Man or Beaſts, there's almoſt a direct Paſſage from one Ear to the other of Birds, ſo that prick but the ſmall Membrane called the *Drum* on either Ear, and Water poured in at one Ear will run out at the other. But what is much more remarkable, they have no *Cochlea*; but inſtead thereof, there's a ſmall *Cochleous*, or Twiſting Paſſage that opens into a large Cavity, that runs betwixt two Skulls, and paſſes all round the Head. The upper Skull is ſupported by many Hundred of ſmall thread-like Pillars, or Fibres, which, as we ſuppoſed, had another Uſe alſo, *viz.* to break the Sound from making any confuſed Eccho, and to make it one, and diſtinct. This Paſſage we obſerved, was much larger in Singing Birds, than in others that do not Sing, ſo very remarkably, that any Perſon that has been but ſhew'd this, may eaſily judge by the Head what Bird is a Singing-Bird, or has Apitude thereto, tho' he never ſaw the Bird before, or knew what Bird it were. This has often made me reflect how much the Modification of Voices depends upon the Accuracy of the Ear, and how Deaf Perſons become Dumb: And ſince, I have obſerved that many Children that have an acute Wit enough, that are ſlow of Speech, that is, long before they ſpeak, are much longer before they can pronounce thoſe Letters that are ſharp, as *g. b. r.* and never have an Aptitude to learn to ſing.

I have alſo anatomized moſt ſorts of Creatures, and never found any Four-footed Creature with an Ear like a Bird, unleſs a *Mole*, and a *Mole* has an Ear much like them, with a very thin double Skull, and a great Cavity like a Bird, and is very acute of Hearing. The Skull, by reaſon of this large Cavity, being very ſlender, is eaſily cruſhed; ſo that a *Mole* is quickly kill'd with a bruiſe on the Skull, like a *Lark*, and upon the bruiſe, the Membranes of the Skull turn black; but when I have taken Care not to bruiſe the Skull, the Membranes were not black at all.

The Anus of Fowls *appli-ed in malig-nant Diſtem-pers, by Mr.* J. Templer, *n.* 86. *p.* 5031.

XCVII. I have obſerved, by Inflation into the *Aſpera Arteria* of Fowls, that there is a Continuation of many Veſicles extended from the *Bronchiæ* through the *Abdomen* to the *Anus*. This, I conceive to be the Cauſe of the conſtant Motion of the *Anus* in Fowls, the Air having Ingreſs and Egreſs there: And alſo that to be the Reaſon why the *Anus* of Fowls are in malignant Diſtempers applied to draw the Infection out of the Body. For thoſe *Anus's* being like *Cups* and *Ventouſes*, the Fowl has often ſtuck by its *Anus* till it died; in which Caſe, I have known ſeven Chickens applied to the Groin of one viſited by the Plague, that ſtuck till they died, and the eighth went quickly off, and lived above a Year and half after.

A Blemiſh peculiar to the Eyes of Horſes, *by Dr.* Richard Lower, *n.* 32. *p.* 613.

XCVIII. 1. The Eyes of *Horſes* are peculiarly affected with one Defect, which no Animal beſides is troubled withal, as far as I have obſerved; and that is, a ſpungy Excreſcence (commonly of a dark Muſk-Colour) which grows out of the edge of that Coat of the Eye, called the *Uvea*. If this ſpungy Subſtance be ſo great, or the Number of them ſuch, as that they grow in ſeveral Places about the Pupil of the Eye, where it contracts its ſelf, the Pupil or Sight is very much (if not totally) obſtructed; and conſequently, the Horſe ſees very little, or nothing at all. As I have many times taken notice in ſome Horſes, which being brought into the Sun-ſhine, could not ſee at all, but ſuffered me to touch the Sight of their Eye with my Finger without the leaſt Winking; which Horſes being led back into the Stable, the *Uvea* in that obſcure Place, dilating it ſelf, they could ſee very well again, and would not ſuffer me to ſhew my Finger near to the Eye, without frequent cloſing their Eye-lids, and toſſing their Heads. The ſame Horſes I underſtood by the Owners, were very apt to ſtumble in the Day-time, if it were Bright and Sun-ſhine, but travelled very well, and ſecurely in the Evening, and in dark cloudy Weather.

I cannot think that theſe Excreſcencies come from ſtraining in great Draughts, and Races, or from hard Travel: Becauſe I have ſeen very large Spunges (as I may call them) in young Eyes of two and four Years old, before they were backed; which, after they have been taken up from the Graſs, and kept with dry Meat, have very much abated, and afterwards being turned to *Graſs* in the Spring to cleanſe and cool their Bodies, have increaſed again to the wonted bigneſs.

It is remarkable, that the more and greater thoſe Excreſcencies are, the more the *Pupil* of the Eye or the Sight is in danger of being quite obſtructed; which you may further examine, by turning the Horſe's Eye to the Light, and obſerving how much of the *Pupil* they do obſtruct. That thoſe on the upper Edge of the *Uvea* are apt to grow the largeſt, and hinder the Sight moſt; and that that which grows on the middle of the *Uvea*, does more hinder the Sight, by diſtracting the Object, than that which grows in either Corner or Angle of it.

I ſuppoſe, no Cure can be expected but from a drying kind of Diet; yet perhaps outwardly ſomething may be deviſed to ſhadow the Eyes, and keep 'em from being nakedly expoſed to the Sun, whereby the *Pupil* will not be ſo cloſely contracted, and conſequently, the Sight not ſo much obſtructed.

By —, *n.* 17. *p.* 750.

2. Horſes of an *Iron-Grey*, or *Dapple-Grey*, are freqently inclining to loſe one or both Eyes, if back'd or hard ridden too ſoon.

In Man and Beaſt, (in Horſes at leaſt) the right Eye is the weakeſt, and moſt frequently failing.

The Pupil, or Black of the Eye is wider and larger in thoſe that are ſhort-ſighted, than in thoſe that ſee at greater Diſtance.

I have often noted ſome that are ſhort-ſighted, I ſay not pur-blind, to diſcern all things that are done about them, almoſt quite behind them, more perfectly than the beſt ſighted, if the Room was not too large for the Reach of their Sight.

Alſo ſome of Dr. *Lower*'s Obſervations I could confirm by my own Experience. In my youngeſt Days, I had a very narrow Eſcape from an excellent Horſe, which had that only Defect, which they call Moon-blind, (and they told me of it after the Miſchief:) I purpoſed to leap a Ditch, but the Horſe ſaw no Ditch, ſo we fell in together.

As Coach and Cart-Horſes have Flaps on the Ear-ſides of their Eyes, ſo theſe Flaps may be fitted (and in ſome Shew of Ornament) to ſhadow the over-Part of the Eyes, and yet to afford them Light enough to ſee their Way. I know not whether it be uſual amongſt you; but I have ſeen a young Child wear a kind of black Ribbon, like a narrow Maſk before her Eyes, the Ribbon-Maſk having Holes made in fit Places to guide the Eye: And this was ſaid to be an effectual Remedy to cure the Child of Squinting, which ſhe had hereditarily from her Mother.

A Horn hanging at the Neck of an Ox, by S. Malphigi, *n.* 166. *p.* 601.

XCIX. About twelve Years ago, I went together with *Meſſ. Charles Fracarſatus*, and *Silveſter Bonfiliolus*, two very worthy Men, to view an Ox that had been killed, having a remarkable Horn hanging from the right Side of his Neck, at that Part of it where the Yoke reſts. The Length of it was about ſixteen Inches; and its Circumference not far from the Root, where it was thickeſt, eight Inches. Its Figure was conical, ending in an obtuſe Point, and near the Extremity it was remarkably crooked. In the Baſis however, where it was joined to the Neck, it became ſmaller: Towards its Extremity it was of a ſhining blackiſh Colour, like that which you frequently obſerve in an Ox's Hoof. Externally it was rough, eſpecially from the Baſis to the Middle of it; for the Cuticle together with the *Corpus Reticulare*, and *Papillæ* below it (which in other Parts uſually riſe perpendicularly, and conſtitute the Organ of Touch) began gradually to ſtretch out and incline towards one another, almoſt in the ſame Manner as you may obſerve at the Roots of the Nails in the Extremities of the Fingers. Theſe *Papillæ* then, ſurrounded with the crumpled Scarf Skin and Corpus Reticulare, and ſtretching themſelves out in Length, were ſo inclined and faſtened together at their Extremities, as to reſemble a good deal the ſcaly Teguments of Fiſhes. Towards the Root theſe ſcaly Bodies were ſhort, but became gradually longer, and were longeſt near the Point or Tip of the Horn. Its Texture was likewiſe different in different Parts; for in the Baſis theſe Papillæ were not connected ſo ſtrictly to one another, but that they allowed a rough crumpled Subſtance to riſe up between their Extremities. But beyond the Middle their Connexion was more compact, and hence they put on a more ſmooth and ſhining Appearance. Within it was hollow, and the Thickneſs at the Baſis was very little more than the natural Thickneſs of the Hide; but becoming thin, it put on the Appearance of a Membrane, plentifully ſupplied with Blood-Veſſels, which lined the Horn internally; and that being removed, the ſmooth ſolid Subſtance of the Horn appeared. The whole Cavity of it was filled with a yellowiſh muddy Serum, which being expoſed to the Fire coagulated almoſt like the White of an Egg. Under the Root there were a great many conglobated Glands, but remarkably depreſſed.

It is plain then from a careful Inſpection of this Horn, that thoſe *Papillæ* (which I have taken not unjuſtly to be the Organ of Touch) covered by the *Cuticula* and *Corpus Reticulare*, whenever they are produced longer than uſual, and intimately united with one another, they end in a ſolid Body; as is common in Horns and Hoofs, which only differ from one another in the external Configuration, and the ſmaller or greater Denſity of their Parts. Whence they may be conſidered as an Addition to the *Senſorium*, and conducing not a little to the Touch. Obſerving the Production of the Horns ſprouting out from the Skull throws a good deal of Light upon this Affair. I hope you will not be diſpleaſed then if I give you by Way of Supplement the Hiſtory of this Vegetation or ſprouting of the Horns in Oxen.

In the *Fœtus* then, contained in its Mother's Belly, the Skull in that Part from which the Horns ſprout out, is almoſt cartilaginous, and is lateſt of becoming bony. The Hairs ſprout firſt out there, excepting a few about the Lips, the Skin remaining ſtill ſmooth in other Parts; and they are placed in ſuch a Manner as together to form a Bone. In the laſt Months, before the Fœtus comes into the World, the bony *Lamellæ* of which the *Cranium* is compoſed, begin to ſtretch themſelves in that Part obliquely outwards, containing within them little roundiſh empty Spaces, whence there riſes upon the Skull a bony Tumour of a lenticular Figure. This is covered with the Skin, which is thicker here than elſewhere, and diſcovers ſeveral turgid Glands between the Skull and the Skin and Perioſteum, or Rudiments of the Horns, which ſhew themſelves by Degrees. After the Calf is born, the lenticular bony Tumour gradually increaſes, by the bony Lamellæ becoming larger, and more turgid, ſo to ſpeak. Over the Bone is ſpread a very thick Perioſteum, the Rudiment of the future Horn, which again is covered by the Skin, as are alſo the *Papillæ* and Aſh-coloured *Corpus Reticulare:* Here too grows Plenty of Hairs in different Directions. After it is one Month old, the bony Subſtance with its Lamina and void Spaces or Cells protuberates; ſo that you may ſee the Rudiment of the Horn fairly puſh out, repreſenting a Kind of obtuſe Cone. Its external Surface becomes gradually ſmooth and ſlippery, and of a blackiſh Colour. There is a Sort of thick Skin extended over it, from which the *Papillæ* burſting forth, and freed from the Aſh-coloured Reticular Sheath, are ſtretched out, and glued together with a black Juice. Theſe about the Root of the Horn are directed obliquely towards its Tip: But the others which riſe towards the Top, ſprout out almoſt perpendicular, and are contained within the *Corpus Reticulare.* Theſe are ſcarce as long as the Pile of Velvet. In the mean Time the incloſed bony Appendix increaſes and has various Configurations internally. For the Root for the moſt Part is fiſtular, compoſed of bony Fibres woven together in a Kind of Net-Work; but the reſt of it, even to the Tip, is a ſpungy Subſtance. There are Blood-Veſſels running between, and the Tip which is always ſoftiſh at this Time, is not of a firm Texture. The Skin likewiſe is extended over the bony Subſtance, and is thickeſt in the Baſis. From this then the *Papillæ* of the Touch emerging, are lengthened out ſo, that inclining towards the Point, and united together by the *Corpus Reticulare,* they conſtitute a Number of hollow Cones, and from the Union of theſe (as of ſo many *Lamellæ,* like thoſe of Onions, placed within one another) the ſolid Body of the Horn is compoſed. The Rows of *Papillæ* that riſe out from the Baſis, although they do not all reach as far as the Tip, for the moſt Part however are produced ſtreight forwards, and almoſt ſurround the Horn. Others are likewiſe propagated in different Planes from the Skin, the longer ones incloſing as it were the ſhorter; whence the Horn being cut longitudinally, not only the bony Subſtance occurs, but likewiſe the Skin from which the ſoft *Papillæ* puſh out, which being changed into the Subſtance of the Horn become ſolid and black, and the Bone being tore off with the ſurrounding Skin, the Tubes of the Horn appear compoſed of a bony Net-Work. You likewiſe meet with various Rows and Planes of the *Papillæ* of the Touch, and their Productions as far as the Extremity of the little Horn; and as theſe different Planes make up the Extremity of the Cone, hence it is that its Point is about the Thickneſs of one's Finger. Theſe *Papillæ* which compoſe the Baſis of the Horn are ſtill ſoft, and eaſily torn, or fly off in Scales; but towards the Point they are ſo compacted, and ſo firmly connected together by the *Corpus Reticulare,* that they become quite ſolid, and put on a ſhining black Colour. Their Progreſs is very evident;

for they appear to be compoſed of a Number of Filaments running longitudinally upon the Horn.

As ſoon as the Horns become about twelve Inches long, the included bony Part is increaſed in its Length, and where it is not a continued bony Canal, you ſee it compoſed of a great many bony Cells. This Structure appears plainer upon cutting the Horn longitudinally; for at firſt you ſee the Bone externally formed into a Tube, from the Inſide of which run a-croſs bony Lamellæ, which meeting with one another, form a great many bony Cells of different Figures and Sizes, and all theſe Cells are lined with a thin Membrane, plentifully ſupplied with Blood-Veſſels. Towards the Tip the bony Subſtance puts off its Cellular Appearance, and becomes more properly ſpungy, and appears very red from the great Number of Blood-Veſſels with which it is ſupplied, and which are diſtributed all through it.

This bony Part above deſcribed is covered by the Skin or Hide become much extenuated, from which are produced ſoft *Papillæ* like thoſe of the Touch, which being ſheathed in the *Corpus Reticulare*, and cloſely compacted together, are ſtretched out towards the Tip, and compoſe the true Horn; by which Means the Sides of the Horn which are thin at the Baſis, become gradually thicker by the Addition of new *Papillæ*, and at laſt towards the Tip, when they are all united together, the horny Subſtance is about two Inches thick.

The internal Surface of this bony Part is black, and made rough by a great many ſmall Foramina directed towards the Tip, through which the *Papillæ* paſs. Externally the Tip is ſharp, ſolid, lucid, and black. Towards the Middle however the Horn on the Outſide is whitiſh, and towards the Root inclining to black, and eaſily ſeparating into Scales.

The Horns ſtill perſiſting in their Growth, at length the firſt Rows of the *Papillæ*, which riſe from the Baſis, being puſhed by the bony Subſtance are broke off from the Skin, whereby the Extremities and Borders of the *Papillæ* appear, not unlike what we ſee in the Shell-Fiſh, whoſe Shells ſeem compoſed of a great many ſmaller ones laid upon one another in ſo regular a Manner, as that the End of each Plane has a Reſemblance to all the others. The ſame Structure is likewiſe conſpicuous in the Horns of the Roe Buck, whence from their Roots to the Middle you may obſerve ſeveral Roughneſſes like little Knots, which are produced from the different Layers of *Papillæ* tore from the Hide at different Times, and retracted upwards, as is evident from examining them carefully with a Microſcope.

Laſt of all, the Horns being arrived at their full Growth, are conſiderably altered; for externally their Colour becomes various, their Subſtance more ſolid, almoſt diaphanous, and ſmooth by continual Uſe. Internally the bony Subſtance terminates in a blunt Point, and its whole Length is ſtill covered with the extenuated Hide. The *Papillæ* of the Touch formerly emerging from this are obliterated, eſpecially in the Point: For the internal Surface of the Horn, by the *Vaginulæ* or Extremities of the *Corpus Reticulare* diſappearing, from the Redundance of that Fluid which glues the *Papillæ* together,

ther, towards the Baſis becomes intirely ſmooth and poliſhed, ſo that the Productions of the *Papillæ* are as it were obſcured.

I have likewiſe obſerved the Production of the Spurs of Cocks analogous to this; for they alſo ariſe from the Cuticle and the *Papillæ* below, included in the *Corpus Reticulare*, ſo that the bony Subſtance increaſing within in its Bulk, the Skin is ſtretched out upon it with different Layers of the Scarf Skin, and a new Horn as it were, though exceeding ſmall, is produced.

From what has been ſaid then we may conjecture, that the monſtrous Horn in this Ox, took its Origin not ſo much from the further Production of the *Papillæ*, Hide, and *Corpus Reticulare*, but from the internal Tumour endeavouring to protrude itſelf, and the Compreſſion made upon the Neck by the Yoke; for in the natural Production of Horns, the bony Subſtance ſprouting out, gradually puſhes forwards, and carries along with it the extended Skin, ſo that the *Papillæ* towards the Tip are conſiderably lengthened. But in the monſtrous Horn theſe *Papillæ* were probably inlarged, or became luxuriant from the redundant Fluid paſſing through the reticular Filaments of which the Hide is compoſed, into the *Papillæ* continued from it, and into the mucous *Corpus Reticulare*, as happens on the growing of the Hoofs, which are produced from the Extremities of the *Papillæ*, and would grow into a deformed Length, if they were not either pared, or wore away by Attrition. It is probable likewiſe, that from the Weight of the incumbent Yoke, the neighbouring Part of the Neck muſt become callous from the Preſſure: For the Motion of the Blood in that Part is thereby hindered; the Humours which uſed to flow through the Skin are ſtopped; and the Sweat and Perſpiration obſtructed in their proper Veſſels; whence the *Papillæ* of the Touch are affected both as to their Subſtance and Situation or Direction, and the *Corpus Reticulare*, which is naturally mucous, becomes of a bony Conſiſtence. But this gluing together of the *Papillæ* very probably happened from a vitriolick Humour flowing through the Excretory Veſſels of the Skin, or at leaſt from the acid Effluvia confined and fixed, while at the ſame Time the Alkaline and watery Particles flying off, there is produced a ſolid and almoſt lucid Body, like hardened Serum of the Blood.

A Lamb ſuckled by a Weather, *by Mr.* Thomas Kirke, *n.* 214. *p.* 263.

C. Sir *Will. Lowther* (in *Yorkſhire*) had a *Lamb*, 1694, which, being left by the *Ewe*, ſuck'd a *Weather* (*Aries Caſtratus*) and brought him to Milk, and was maintained by him all Summer till the latter end of *Auguſt*, that he was Weaned. I ſaw his Udder the latter end of *September*, each ſide whereof was about the bigneſs of a Hen's Egg; and he had two conſiderable Teats. I ſaw Milk ſpurted out of them, to a Yard or two's Diſtance, notwithſtanding the *Lamb* had been taken from him ſo long. In *November* I ſaw him again, but his Udder was then much fallen, each ſide being now about the bigneſs of a *Walnut*; there is Milk ſtill in it, enough to Stream out above half a Yard.

There is no Token at all of a *Hermaphrodite* in him. I compared him with another *Weather*, who had Teats or Paps like him, and differed in nothing but the Udder. The *Ewe* died upon Shearing, when the *Lamb* was about five Weeks Old; ſo 'tis likely it might feed partly upon Graſs, as I ſuppoſe other *Lambs* of the like Age do, notwithſtanding what they ſuck from their Dams.

Graſs *found in the Wind-Pipe and Lungs of ſome Animals, by Mr.* Rob. Boyle, *n.* 6. *p.* 100.

CI. Dr. *Clark* and Dr. *Lower* have given me an Account of a pretty odd kind of Obſervation: One of them aſſuring me, that he had ſeveral times in the Lungs of Sheep found a conſiderable Quantity of *Graſs*, in the very *Branches* of the *Aſpera Arteria*; and the other relating to me, that a few Weeks ſince, he, and a couple of Phyſicians, were invited to look upon an *Ox*, that had two or three Days almoſt continually held his Neck ſtraight up, and was dead of a Diſeaſe the Owner could not conjecture at; whereupon, the Parts belonging to the Neck and Throat being opened, they found the *Aſpera Arteria*, in its very Trunk, all ſtuffed with Graſs, as if it had been thruſt there by main Force: Which gives us juſt cauſe to wonder both how ſuch a quantity of Graſs ſhould get in there; and how, being there, an Animal could live with it ſo long.

A Murrain *in* Switzerland, *and its Cure, by Dr.* Wincler, *n.* 145. *p.* 93.

CII. 1. On the Borders of *Italy* a *Murrain* infected the Cattle, which ſpread farther into *Switzerland*, the Territories of *Wirtemberg*, and over other Provinces, and made great Deſtruction amongſt the Cattle. The Contagion ſeemed to propagate it ſelf in the form of a *Blue-Miſt*, that fell upon thoſe Paſtures where the Cattle grazed, inſomuch that whole Herds have returned home ſick; being very dull, forbearing their Food, moſt of them would die away in twenty-four Hours. Upon Diſſections, were diſcovered large and corrupted *Spleens*, *Sphacelous Corroded Tongues*, ſome had *Angina Maligna's*. Thoſe Perſons, that careleſly managed their Cattle without a due reſpect to their own Health, were themſelves infected, and died away like their Beaſts. This Contagion may probably proceed from ſome Noxious Exhalations thrown out of the Earth, by three diſtinct Earthquakes perceived here, and in our Neighbourhood in the ſpace of one Year.

The Method of Cure was thus: As ſoon as ever there was any Suſpicion of the Contagion upon any one of the Herd, the Tongue of that Beaſt was carefully examined: In Caſe they found any *Aptha*, or Bliſters, whether White, Yellow, or Black, then they were obliged to rub, ſcratch and tear the Tongue till it bled; then they wiped away the Blood and Corruption with new unwaſhed Linen; this done a *Lotion* for the Tongue was uſed, made of Salt and good Vinegar. The *Antidote* for the Diſeaſed Cattle, and the *Medicine* for the Sick was the ſame; *viz.* Take of *Soot*, *Gun-Powder*, *Brimſtone*, *Salt*, equal Parts, and as much Water as is neceſſary to waſh it down; give a large Spoonful for a Doſe.

By Dr. Fred. Slare, ib. *p.* 94.

2. I am aſſured, by two ingenious Travellers, that this Contagion reach'd the Borders of *Poland*, having paſſed quite through *Germany*; That it

was obſerved to make its Progreſs daily, ſpreading near two *German* Miles in twenty-four Hours; that it continually without Intermiſſion made Progreſſive Voyages, and ſuffered no neighbouring Pariſh to eſcape; ſo that it did at the ſame time infect Places at great Diſtances, that Cattle ſecured at Rack and Manger were equally infected with thoſe of the Field. It were worth conſidering whether this Infection is not carried on by ſome Volatile Inſect, that is able only to make ſuch ſhort Flights as may amount to ſuch Computations.

The Diſeaſes of Dogs, by Sir Theod. Mayerne, *n.* 191. *p.* 408.

CIII. *Dogs* are ſubject to theſe Diſeaſes. 1. The *Hot Madneſs*, which is Incurable; they fly upon every thing, and can hold out but four Days. 2. The *Running Madneſs*, which is likewiſe Incurable; they fly only upon Dogs, and that by Fits, and may ſometimes hold out nine Months. 3. *La Rage Mue*, which is a Diſeaſe that lies in the Blood. 4. The *Falling Madneſs*, which ſeizes on the Head, and is a ſort of *Epilepſy*. 5. The *Blaſting*, or *Withering*; this lies in the Bowels, which ſhrink up exceedingly. 6. The *Sleepy Diſeaſe*, which comes from little Worms in the Mouth of the Stomach, theſe *Dogs* die ſleeping. 7. The *Rheumatick Diſeaſe*, this ſwells the Head very much, and makes the Eye Yellow. In theſe five latter Diſeaſes the *Dogs* will not eat, (nor at any time when they are ſick,) but they live eight or nine Days without hurting any Body, and then die of Hunger.

The two firſt are catched by the Breath of *Dogs* being together, as in the Plague among Men; the latter are likewiſe contagious, but curable.

Obſervations on the Diſſection of a Rat; *By Mr.* Rich. Walker, *n.* 166. *p.* 594.

CIV. The Fore-feet of a Rat reſembleth thoſe of the *Caſtor*; The Hair is alſo ſome Fine, ſome Coarſe, as in that Animal; the *Tail Scaly*, with Hairs between every Scale, like the *Caſtor*'s, which ſhews theſe two Animals to be ſomething a-kin: And indeed the *Water-Rat* comes very near to the *Beaver*, and makes its Holes in the Bank-ſides of Ponds after the ſame manner.

Fig. 247.

The *Penis* in the *Rat* has a particular Paſſage near the Navel, as in *Squirrels*, and not at the *Anus*, as in the *Caſtor*.

The Liver is full of little Specks, as big as Pins heads; which are the little Glands thereof.

There was no Gall-Bladder, but a *Ductus Felleus*, poſſibly the Bladder was incloſed in the *Parenchyma* of the Liver, as it is in ſome Animals.

The *Cæcum* was much larger than the Stomach, and in ſhape like that of the *Caſtor*.

The Teſticles lay not behind, but in the Groins on the *Os Pubis*. Theſe were like a Bottom or Skein of Thread rumpled up together, which was viſible through the Coats of the Teſticle. This Thread continued of near the ſame Size in the *Epididymides*, only towards the *Deferentia* it grew larger.

It was tender, and not eaſy to be unravel'd; ſo that I could not draw out above three Quarters of a Yard.

The *Proſtratæ* lay under the Spermatick Arteries.

The Kidneys were whitiſh, with their *Succenturiati.*

At the Neck of the Bladder were inſerted the *Veſiculæ Seminales*; tranſparent and filled with the *Semen.*

Toward the end of the *Penis,* which had a Bony Griſtle, were two large Glands emptying themſelves near the End of the *Penis,* and contained a Subſtance like Cream, as in the *Dormouſe*; obſerved by *Swammerdam.*

A A. The *Kidneys*; *a a.* the *Renes Succenturiati*; *b b.* the *Ureters*; *c c.* the *Crural Veins* and *Arteries*; *D.* the *Arteria Magna*; *e.* the *Vena Cava*; *F.* the *Bladder*; *g g.* the *Spermatick Veſſels, Veins* and *Arteries*; *h h.* the *Teſtes, with* the Branches of the *Veins* and *Arteries*; *i i.* the *Epididymides*; *k k.* the *Deferentia*; *l.* the *Penis*; *m m.* the *Veſiculæ ſeminales*; *n n.* two *Glands,* from whence a thick Juice might be preſſed out; *o.* the *Balanus.* *Explication of the Figures.*

CV. 1. The *Sable-Mice* (which were firſt obſerved in *Lapland* about *Thorne* 1697) are near as big as a little *Squirrel*: their Skin ſtreaked, and ſpotted black and light-brown; they have two Teeth above, and as many under, very ſharp and pointed; their Feet like thoſe of *Squirrels,* they are ſo fierce, and angry, that if a Stick be held out at them, they will bite it and hold it ſo faſt that they may be ſwing'd about in the Air; they are fat and thick, and without any *Tail.* *Sable Mice, By Sir P. Rycaut, n. 251. p. 110.*

In their March they keep a direct Line, generally from North-Eaſt to South-Weſt, and are innumerable Thouſands in each Troop, which for the moſt part is a Square: They march by Night, and in Twilight, and lie ſtill by Day. The diſtance of the Lines they go in is of ſome Ells, and Parallel to each other. If they meet any thing that might ſtop them, they avoid it not, tho' it were a Fire, a deep Well, a Torrent, Lake, or Moraſs, but without any Heſitation venture through, and by that means many Thouſands of them are deſtroyed. If they be met ſwimming over Lakes, and be forced out of their Courſe, they preſently return into it again; when they are met in Woods or Fields and ſtopt, they ſet themſelves upon their hinder Feet, like a Dog, and make a kind of Barking or Squeaking Noiſe, leaping up as high as a Man's Knee, defending their Line as long as they can: And, if at laſt they be forced out of it, they creep into Holes, and ſet up a Cry ſounding like *Biabb, Biabb.* They never come into any Houſe, nor meddle with any thing that is Man's Meat; if a Houſe happen to be in their Way, there they ſtop till they die, but through a Stack of Hay or Corn they will eat their Way: when they march through a Meadow, they endamage it much by eating the Roots of Graſs, but if they encamp there by Day, they quite ſpoil it, and make it look as if it were burnt, or ſtrewed with Aſhes. The Roots of Graſs, with rotten Wood, and the Inſects in it, are their chief, if not only Food.

Theſe Creatures are very fruitful, yet their Breeding does not hinder their March, for ſome of them have been obſerved to carry one Young One in their Mouth, and another on their Back.

It is reported that ſome poor *Laplanders* have eat ſeveral of them, and found their Fleſh to taſte like Squirrels; Dogs and Cats eat only the Heads, and Birds of Prey only the Heart. During the Winter they lie under the Snow, and have their Breathing-Holes upon the top of it, as Hares and other Creatures uſe to have. The Country-People are very glad of thoſe Gueſts, foretelling there will follow great Plenty of Game, as of Fowls Squirrels, Lo-Cats, Foxes, *&c.* where of late Years there has been great Scarcity, being told by ſome old People that theſe ſort of Creatures were ſeen in *Lapland*, about 20 or 30 Years before, and that thereupon they had Abundance of ſuch Game.

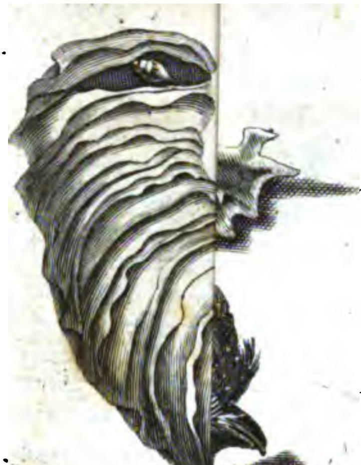
By —— Ib. *p.* 11. 2. Theſe *Mice* are the ſame with thoſe called *Mures Norwegici*, deſcribed by *Olans Wormius* in his *Muſæum.*

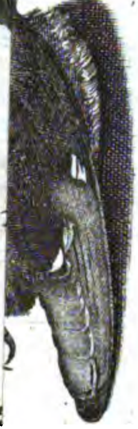
The Ruſſian *Way of curing* Caſtoreum; *By* ... *n.* 263. *p.* 561. CVI. Take *Bever-Stones*, and get the Milk out of them as clean as you can, then ſet upon the Fire a Skillet or Kettle with Water big enough to contain the quantity of Stones you have to cure: Let the Water boil, and put into it half a Shovel-full of Clean Wood-Aſhes; then tie the Stones together in Couples, and put them into the Water, and let them boil therein for half a quarter of an Hour, then take ſome Birch-Bark, and lay it on the Fire, and let the Stones be well ſmoaked over it for the ſpace of an Hour, until they are well dried in the Smoak; then hang them up in a Kitchen, or in the Air, for a Week or more, until they are perfectly dry and hard, after which they may be packed up in a Caſk, or otherwiſe for *Tranſportation.*

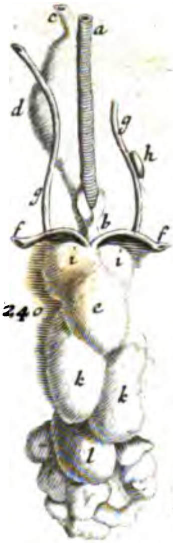
The Muſk-Quaſh, *by* --, *n.* 127. *p.* 653. New-England's *Rari-* CVII. That the Teſticles of the Animal in *New-England*, call'd *Muſk-Quaſh*, do ſmell ſtrong of Muſk (as Mr. *Joſſelin* faith,) is moſt certain: For, I have known ſome of them kept a long time in one's Pocket, till they were become hard and black, and yet ſmelt as ſtrongly as at firſt, which in my Opinion was nothing inferiour to the Scent of that which is commonly ſold for *Muſk* in the Shops. I remember that one of our Seamen, being laid to ſleep too near the Fire-place, with one of theſe dried *Teſticles* in his Pocket, it happened that a Coal burned through his Breeches to it, and made ſo great a Scent of *Muſk*, that he might eaſily have been ſmelt a good way off.

This Animal deſerves to be further enquired into, eſpecially if what M. *Thevenot* relates be true; *viz.* That *Muſk* is nothing elſe but the *Teſticles* of a Beaſt like a *Deer*, found in *China*, in the Province of *Honan.*

The Anatomy of a Mexican Muſk-Hog, *by Dr.* Edw. Tyſon, *n.* 153. *p.* 359. CVIII. The whole ſhape of this Animal (which by ſome Authors is called *Tajacu*) was ſuch, that we may eaſily reduce it to the Swine-kind, as plainly appears by the Figure; but it was much leſs than our uſual Hogs; for from the end of the Body, where the Tail ſhould be, to the top of the Head between







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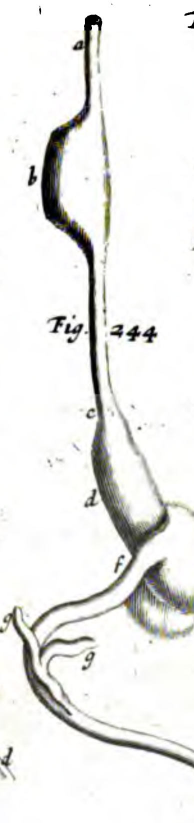
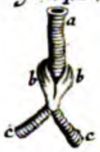
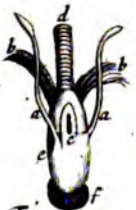


Fig. 244

Fig. 241





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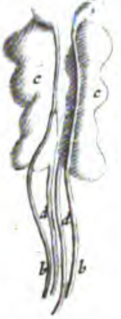

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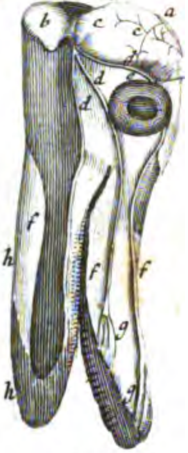

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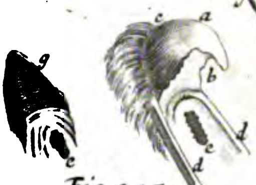
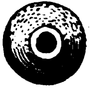


Fig. 245

Fig. 217



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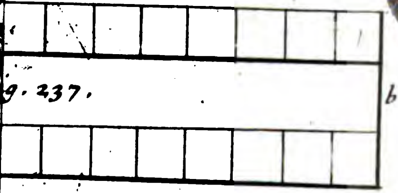
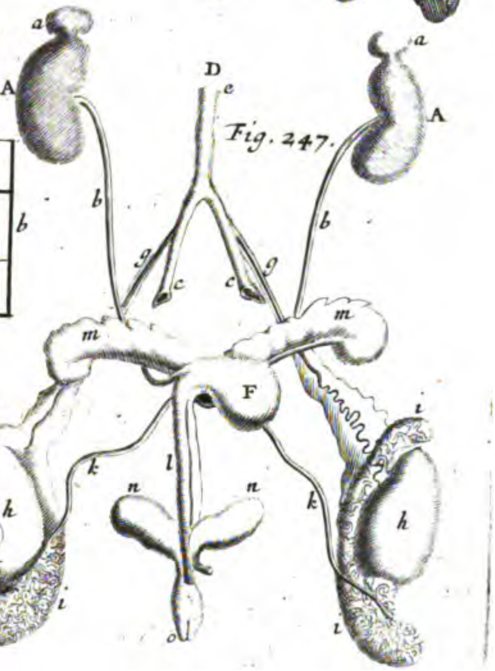
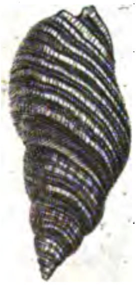


g. 237.

Fig. 247.





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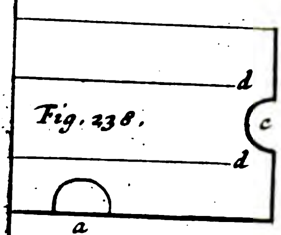


Fig. 238.

tween the Ears, were two Foot and two Inches, from thence to the end of the Noſe eleven Inches; the Girth of the Body two Foot; the Girth of the Neck ſixteen Inches; of the Head, in the largeſt place, eighteen Inches; and of the Snout twelve Inches: For the lower Jaw in this *Mexico-Hog* was more protuberant, and the Head leſs tapering than in our Swine, and in the *Sceleton* appears much like that of a *Baby Rouſſa*, only it had not thoſe Teeth; and the Neck appeared ſo very ſhort and thick, not from thoſe large Glands, which in ſome of the Swine-kind do ſo ſtuff out their Necks, but from the ſhort turning upwards of the *Vertebræ* of the Neck, which were kept cloſe to the Body, by the Inſertion of that ſtrong Ligament into the Poll from the Back, which in Animals that are *Prono Capite*, is of extraordinary uſe; and much adds to the Strength of this Animal. The Colour of the Body was Griſly; being beſet with Briſtles, which were thicker than thoſe of a *Hog*, and leſſer than thoſe of a *Hedge-Hog*; but like thoſe of a *Hedge-Hog*, or the Quills of a *Porcupine*; they were variegated with white and black Rings. The Belly was almoſt bare. The Briſtles on the Sides were ſhorter, and gradually increaſed in length, as they approach'd the Ridge of the Back; where ſome were five Inches long. Between the Ears, on the Head was a large Tuft of theſe Briſtles; which were for the moſt part black. The Ears were about two Inches and a half long, and pricking up; the Eyes (as they are uſually in Pigs) but ſmall; from the lower *Canthus* to the end of the Noſe, ſix Inches; the Noſe like that of a *Hog*, the Mouth not large, one ſide of the lower Lip made ſmooth, as it were by the rubbing of a Tuſk in the upper Jaw; the Feet and Claws perfectly as in common *Hogs*, only in the upper Claws on the ſame Foot proportionably longer, being one Inch and a Quarter long, whereas the true Claws were ſcarce one Inch and an Half. It had no Tail. But what is moſt particular, and differences it from any other Animal I know of in the World, is the Feet, or Navel, or *Foramen* rather, on the hinder part of the Back. *Fig.* 248. *Fig.* 250.

Theſe Animals are bred in *New-Spain*, *Nicaragua*, *Terra Firma*, and *Braſil*: They are uſually met with in the Mountains and Woods, and go in Herds together. They feed on Roots, Acorns, and Fruits; but, as the greateſt Delicacy, they hunt for all manner of Poiſonous Serpents and Toads; and having caught them, holding them with their Fore-Feet, with a great deal of Dexterity, with their Teeth they ſtrip off their Skin from the Head to the Tail, then greedily devour them. *Poſtea*, (ſaith *Jo. Faber*, who had the Account from *F. Gregorius*, who often has ſeen them, and lived in thoſe Parts twenty-four Years) *Radicem ſeu certæ Arboris Corticem ſibi notum quærit, quem comedit, ne Veneno inficiatur; & hæc ratione optimè nutritur. Creſcit & augeſcit.* When they are made tame, they will feed on any thing; but naturally they are very fierce. Hiſt. Anim. Mexican.

Ovideus remarks, that the Swine, which the *Spaniards* left on the Iſlands of St. *Domingo*, St. *Joannes*, and *Jamaica*, multiply'd and encreaſed; but thoſe in *Terra Firma* durſt never go in the Woods, but were deſtroyed by the *Lions*, *Tigers*, and *Lupi Cervarii*: Yet in theſe Woods there are great Herds of theſe

Trajacu's that can make their Party good with the fierceſt of them. If any be wounded, preſently he gets to his Aſſiſtance a great Number of his Kind, and never leaves till he has revenged the Injury, or is ſlain. They are always at Enmity with the *Tygers*; and there is often found the Body of a *Tyger*, and abundance of theſe *Tajacu's* ſlain together. If they ſpy a Man, they will fiercely ſet on him, and his beſt Eſcape is to get up a Tree, which they will moſt furiouſly aſſault with their Teeth; nor will eaſily leave him, till forced by Hunger, or ſlain by him, by Club, Darts, or a Gun. If they hunt them, their Dogs are often torn in pieces by them. Their Fleſh is eſteemed very good, and much deſired by the Inhabitants. They have but a very little Fat. Our Subject had ſcarce any.

We come now to the Anatomy; having therefore divided the Muſcles of the Belly, we took notice of the remarkable Structures of the Stomachs; for it *Fig.*253. had three. Into the middlemoſt was inſerted the *Œſophagus*, or Gullet; which we therefore ſhall call the *firſt Ventricle*, or Stomach. From this, on one ſide was a large Paſſage into the Second, which pouching out had its two ends winding like a Horn, and on the other ſide of the Firſt or Middle-Stomach was a free open Paſſage into the Third, which emptied it ſelf into the *Duodenum*. *Fig.*254. The firſt Stomach was lined within, with a white thick hard Membrane, almoſt like the inward Pellicle of the Gizzard of Fowls; with which none of the other Stomachs were endowed: For the Inward Surface of the Second was ſmooth and ſoft, its Membranes thin, and more inclining to the common make of that of *Carnivorous Animals*: The Third ſomewhat like this, but thicker and rimpled within, with large *Plicæ*, or Folds. Dr. *Grew* takes *Stomach and Guts of Quadrupeds, c.* 3. Notice, that in the *Common Hog*, againſt the *Pylorus*, ſtands a round *Caruncle*, as big as a ſmall *Filberd-Kernel*, like a ſtopple to the *Pylorus*, for preventing (as he conjectures) a too ſudden and copious Irruption of the Aliment. This *Fig.*252. is ſufficiently provided for in our Subject, by the great ſtreightning of the *Pylorus* here, and the great Aſcent it muſt take, before it can go out; which may be the Reaſon too of Nature's making theſe ſeveral Cells, or Partitions, for the better Digeſtion and Maceration of the *Food*; for, it being Frugivorous, Graminivorous, and Carnivorous too, the Stomachs are ſo contrived, that as the Firſt here by its *Inward Pellicle* ſomewhat reſembles that of Birds that are Carpophagous, ſo the others thoſe of Quadrupeds.

The Small Guts, which in other Animals, being faſtned to a large *Meſentery*, uſually do hang down, were here cloſer gathered, by the ſhortneſs of this Membrane, to the Spine: And the *Colon*, which in others is ſuſpended, here by its peculiar Structure lies looſe, and falls down; for the *Duodenum*, ariſing from the *Pylorus* with a ſhort turn, and the other ſmall Inteſtines, made abundance of Convolutions and Windings. And altho' the Meſentery was but very ſhort from the Spine, and its Circumference ſeemingly but very little; yet in this Compaſs it contained 27 Foot of theſe Inteſtines; for ſo much they meaſured from the *Pylorus* to the *Colon*. The *Colon* was not faſtened to the Periphery or Rim of the Meſentery, as ordinarily: But ariſing from the Centre or middle, made a *Spiral Line*, its End hanging looſe, and its turnings cloſely united one to another by Membranes. The *Colon* was very large, in reſpect of the other Guts; and, as I meaſured it, it was nine Foot long. It had a ſhort *Cæcum*, but pretty wide, and fill'd with *Fæces*. What Dr. *Grew* obſerves, that 'tis peculiar to the *Cæcum* of a *Hog*, and that of a Horſe to have the ſame Structure with the *Colon*, is true here too: And it may be reckoned as an *Appendix* of the *Colon*. The Meſeraick Veſſels were alſo extraordinary; for here we obſerved a large Vein and Artery, running a ſmall and equal Diſtance from the Inteſtines, and from them ariſing an infinite Number of leſſer, but ſtreight Veſſels, which going regularly to the Guts, and in great Numbers, afforded a very pleaſant Proſpect.

The *Spleen* was about 10 Inches long almoſt, almoſt of the ſame breadth throughout, and the middle was one Inch and half broad; it was of a Lead-Colour, a little Speckled or Marbled. The Liver conſiſted of four large Lobes, and was of a dark red Colour; it appeared plainly Glandulous; and had no *Veſica fellea*, but it had a *Ductus Bilarius*, which went from the Liver to the *Duodenum* as uſually. The *Pancreas* was about five or ſix Inches long; and was made up of ſeveral Glands.

The *Teſtes* were two Inches long, larger at the upper end than the lower, and in the middle about an Inch broad; they were placed in the *Scrotum*. Their Colour white, their Structure cloſe, ſo that the Veſſels, which compoſed them did not ſo plainly appear as in an ordinary Boar. Notwithſtanding which no doubt, their whole *Compages* was Vaſcular, tho' here cloſer wrought together, and united. Their Uſe is to prepare the *Semen*; which is conveyed thence by the *Vaſa Deferentia* to the *Veſiculæ Seminales*.

Theſe *Deferentia* ariſe near the lower part of the *Teſtes*; and are ſo inſerted, that they might alſo equally empty themſelves either into the *Veſicæ Seminales* or *Uretbra*. The *Veſiculæ Seminales* were one Inch and half long, in ſome places a quarter; in others half an Inch broad.

Tho' call'd *Veſiculæ*, yet here they appeared more Glandulous, nor was their *Cavity* any thing conſiderably large. The common Orifices to them, and the *Vaſa Deferentia*, made a riſing in the Inſide of the *Uretbra*; which *de Gaaf* calls *Caput Gallinaginis*.

In other Animals at this place is ſeated that Glandulous Body, called the *Proſtatæ*: But the *Veſiculæ* here being ſo Glandulous, poſſibly they may perform their Office; unleſs we ſhould aſcribe their uſe to thoſe two Glands which lay on each ſide the *Uretbra*, and emptied themſelves, with two Orifices, near the Root of the *Penis*. Theſe Glands were Cylindrical, of a whitiſh Yellow Colour, an Inch and half long, and three Eighths of an Inch in Diameter. Their Subſtance cloſe, like that of the *Teſtes*, and no perceptible *Cavity* within, and they lay along the outſide the *Uretbra*, reaching from the *Muſculi Erectores Penis*, to the Glandulous *Veſiculæ* before deſcribed. The *Veſiculæ Seminales* being Glandulous, muſt therefore ſecrete ſome Juice, which in all likelihood is ſome ways ſerviceable, tho' not principally, in Generation. The *Penis* was a long ſlender Body, made up of ſeveral Muſcles, whereof two were very long. The *Veſica Urinaria* or Bladder of Urine, was rounder than in ſome other Animals, where uſually 'tis more Oblong, The *Ureters* were inſerted at the Neck of the Bladder, not Sides, as in ſome.

In the *Thorax* we were ſurpriſed at the ſtrange Formation of the *Arteria Aorta*, which, as it deſcends along the Spine, in all other Animals, I have obſerved its Trunk is almoſt of an equal bigneſs, only a little tapering downwards: But here, between the Heart and its Branchings into the Iliac Arteries, we found three large Swellings out. The largeſt was that neareſt the Heart, which after a ſmall ſtreightning, again emptied it ſelf into the Second; which, though ſomething leſs than the Firſt, yet was much larger, than the Third, which was near the Diviſion of the *Aorta* into the *Rami Iliaci*. Two of theſe Swellings I opened, and found within ſeveral unequal Cells, or Hollows, but withal could not perceive but the Membranes here were altogether as thick, as where the Artery was nothing extended. But, this being the only one of the Kind I have diſſected, I know not how far it may be preternatural.

The Aperture of the Eye was but ſmall, as in the Hog kind; the *Membrana Nictitans*, plainer than uſually in Quadrupeds, which might be convenient, ſince, wallowing in Mud, they might the better rub off any Filth that might happen there; the Muſcles not ſo diſtinct, as in ſome Brutes; and hence the Motion of their Eyes not ſo quick nor regular, the Pupil round, the Optick Nerve inſerted almoſt in the Axis of the Eye, and on the inſide made a ſmall Dint, the *Choroides* of a *Pale Violet*, and browniſh Colour.

Juſt on the Ridge on the Back, over the hinder Legs, is ſeated a Glandulous Body, which all Authors call the *Navel*. It is ſo covered by the long Briſtles there, that it was not to be obſerved, but by opening of them with the Hand: And then you ſhall find a ſmall Space there almoſt bare; only beſet with fewer, ſhorter and finer Hairs; and in the Middle of it, the protuberant Orifice of the Gland, by which it diſcharges it ſelf of the Liquor, which is ſeparated by it within. This Orifice, or *Foramen*, had its Lips a little reflected and protuberant, above the Surface of the Skin. It would eaſily admit of a large Probe, which I could turn into ſeveral Parts of the Gland. Upon a gentle Preſſure with my Finger, I could obſerve a ſmall Quantity of a white yellowiſh Juice, and ſome part of it of a little darker Colour; which yielded a very pleaſant and agreeable Scent, and was judged by myſelf, and ſeveral others who ſmelt it, to be much like that of Muſk or Civet. Fig. 251. The Gland it ſelf was ſeated between the Skin, and ſome Part of the *Panniculus carnoſus*: For in the Middle of that Part or Surface, which reſpected the Back, 'twas bare, and not cover'd with that Muſcle, but only the Edges of it encloſed within it; ſo that in taking off the Skin, the Gland too, as I have obſerved, could not eaſily eſcape, but go with it. However, this Muſcle may be aſſiſting to it, by its Contractions, in preſſing out of its Liquor, as the Sphincter-Muſcle is to thoſe Scent-Bags, placed at the Extream of the *Rectum* of other Animals.

This Gland was conglomerated, or made up of ſeveral minute and ſmall white Glandules; it had no conſiderable *Cyſtis*, or Cavity within; but like the *Pancreas* or Salivatory Glands, it had abundance of Secretory Ductus's which terminating at laſt in one, diſcharged its ſeparated Juice by a common Orifice.

This Orifice, having ſomething of a Reſemblance of a Navel, has impoſed almoſt upon all who have writ of this Animal, (and have only ſuperficially viewed this Part, without examining any thing further,) to believe it an *Umbilicus*; and thoſe who have deviated from this Sentiment, have been as unhappy, in delivering altogether as abſurd, and extravagant Conjectures about it.

But there is nothing I can parallel this Gland with, more than thoſe Scent-Bags, or Scent-Glands, I have formerly mentioned to be in other Animals. This I firſt took notice of in *Pole-Cats*, in which, juſt at the Extream of the *Rectum*, were placed two Bags fill'd with a craſſie and whitiſh Liquor, whoſe Stink was ſo very great, that I could not well endure the Room, till I had removed them, and then the whole Body ſeem'd very inoffenſive. The ſame I have obſerved in abundance of other Animals; as in all the *Pole-Cat* kind, in our common Cats; in a Lion; in Dogs; in a Fox, &c. Thoſe Bags in the Civet-Cat, or *Hyeæna Odorifera*, are nothing but the ſame; as are likewiſe thoſe of a *Muſk-quaſh* mentioned above: For they are not the Teſticles of that Animal; for having ſeen the Skins here in Town, and thoſe Muſk-cods, I find them to be only theſe Scent-Bags. So the *Caſtoreum* we have in our Shops is not the Stones of a *Bever*, as formerly reputed, but of the ſame Nature altogether with our Scent-Bags.

Plot's Nat. Hiſt. Oxfordſhire.

Vid. ſuprà. §. CVII.

Vid. ſuprà. §. CVI.

And indeed in moſt Species of Animals there may be obſerved ſomething the ſame, or analogous to it, which gives them their peculiar *Fœtors*, or Smells. Thus I have obſerved in Reptiles, as in the Rattle-Snakes, in Vipers, in our common Snake, &c. two long Bags in the Tail, which empty their fœtid Liquor, near the Verge of the *Rectum*. But in all Animals, I find not theſe Bags or Glands ſeated here, but in ſome, in different parts of the Body: In Fowl and Birds, in the Rumps you will meet with two Glands, which have three Pipes, or Secretory *Ductus*, ariſing on the Top of it, above the Surface of the Skin, which diſcharges a fœtid Liquor. I find theſe Glands the largeſt in Geeſe and Duck-Kind, which uſe the Water; and any one at the Table, by taſting, may perceive in a Duck how ſtrong-ſcented they be. In *Turkeys* 'tis leſs glandulous, but they have a larger *Cyſtis* within. In the *Oſtridge* indeed, I did not obſerve it on the Rump, but ſomething higher on the Back, where it made two Bunchings out, and under the Skin I found a *Cyſtis* fill'd with a concreted yellowiſh Juice. This ſomething approached near the place where was ſeated the Gland in our *Mexico-Hog*, which I call the Scent-Gland, and it yielding ſo grateful a Perfume, (for ſo it was eſteemed by myſelf, and ſeveral others who ſmelt it) from it, I have named it, the *Mexico Muſk-Hog*. But this is remarkable, that as our *Muſk-Hog* has its *Scent-Glands* ſeated on the Back, ſo the *Gazella*, or *Muſk-Deer*, has his *Muſk-Bag* on the Belly, near the *Umbilicus*. Every one obſerves what an horrid Stink the Urine of Cats will make where it lights; perhaps in rendring their Urine at the ſame time they may empty their Scent bags ſeated at the *Rectum*, which mixing with it, in a great Meaſure, may give it its ſtrong *Fœtor*. So the ſame of *Rats*, of *Mice*, of a Fox when hunted, &c.

No Author indeed, has called the Scent of this Animal a Perfume; on the contrary, they have all branded it as a Stink: But even the Beſt Perfumes ſometimes make the greateſt Stinks. *Civet*, nay, *Muſk* it ſelf, when freſh and green, and in large Quantities, are no ways agreeable, but very offenſive to the Smell, as many have obſerved: And what is more too, ſuch as Ambergreaſe at the firſt, as *Gull. Piſo* aſſures us.

Our *Tajacu* therefore, when young, and when but a ſmall Quantity of this Liquor is ſeparated by this Gland, may afford but little or no Scent; and *Foxes*, till they are well grown, do not much ſtink; but afterwards, when in great plenty, this Juice is voided, by its Copiouſneſs, and being thin and fluid, and ſo more Vapourable, it may ſtrike our Organs with ſuch briſk and nimble Strokes, as to create a Pain; whereas a more leiſurely Appulſe of its Particles from a leſſer, and concreted Body, may give a Pleaſure. So our *Tajacu*, when this *Gland* does very liberally diſcharge its Liquor, may be thought to ſtink; and yet this Stink in Time may become a Perfume. Thus that fœtid Liquor in the Scent-bags of a *Weaſel*, having formerly put it on a Paper, and kept it a little while, afforded me a pleaſant Smell. Why therefore we perceived no Stink at firſt, upon the Diſſection of this Gland, but rather a ſweet and pleaſant Smell, (if it is otherwiſe in the Countries, where they breed,) this may be the Reaſon, becauſe it had been dead ſome Days before I examined this Part, and then I found but a ſmall Quantity of an incraſſated Liquor there; tho' I muſt acknowledge, that I was informed, that when it was alive, it was obſerved by the Family where 'twas kept, that wherever it went it left a good Perfume behind it. This I am ſure of, that when 'twas dead, and obſerved by me, and ſeveral others, it yielded a fragrant one; which I think is ſufficient to juſtify, or at leaſt to excuſe the Name I have given it.

We further obſerved, that the *Cranium* ſeem'd entire, without Sutures: From the Noſe to the end of the Pole, eight Inches and a half. Here the *Cranium* grew very narrow, and then did ſpread it ſelf again Triangularwiſe, and behind made a large Hollow where it reſpected the Back, and where were inſerted ſtrong Muſcles, and the Ligament from the Back, I formerly mentioned, by which means the Head is ſo kept ſtraight up, and when alive he ſeemed to have but a very ſhort, if any Neck at all. The *Porus Auditorius*, or Paſſage to the Ear, was ſomething remarkable; being placed near the Pole. In the upper Jaw before were four Teeth, or *Inciſores*; a little further, was placed a large flat Tuſk, ſharp-edged, and ſtanding outwards; and beyond that, of each ſide, ſix double Teeth, or *Molares*. The lower Jaw was ſix Inches and half long, one and half broad at the firſt double Tooth, of which there were ſix of each ſide. The Bone of the lower Jaw here, from the *Dentes Morales* to the *Inciſores*, ſeem'd ſpongy and curious; and the Tuſks in this Jaw were rooted out; as were one or two of the *Inciſores*, which in all were about four.

Fig.249.

There were ſeven *Vertebræ* of the Neck, which meaſured in Length four Inches and a half: The firſt, or *Atlas*, had two broad tranſverſe Proceſſes, but no Spine, the ſecond had a large Spine, the third, fourth, fifth, had no Spines, the ſixth, and ſeventh, had large Acute ones. There were nineteen *Vertebræ* of the Back; the Spines of the firſt, ſecond and third, were about three Inches long, but they gradually decreaſed, as they approached the Tail. The firſt *Vertebræ* of the *Os Coccigis*, was two Inches long; but I thought, that at firſt it might have been ſeveral, though now it was but one Bone. There were about ſix *Vertebræ* more, which ran no farther than the Extent of the *Os Iſchii*. There were fourteen Ribs of each ſide; the *Os Sterni* jutting out about an Inch beyond the ſetting on of the firſt Ribs.

The *Scapula* was five Inches long, the *Os Femoris* of the Fore-foot, five Inches and half long; the *Tibiæ* of the Fore-foot, about the ſame length in the whole; but from the Juncture with the *Os Femoris* to the *Os Metatarſi*, was but 4 Inches; for from the Juncture with the Thigh-bone, it jutted out farther, as in the Figure. The Bones of the *Tarſus* were 5, of the *Metatarſus* 3, about 2 Inches long; the Bones of the *Digiti* 9, there being two to each Claw, and 3 Claws to each fore-Foot. The *Os Femoris* of the hinder Foot, was almoſt ſix Inches long; and near its Juncture with the *Os Tibiæ* it had a ſmall Bone, like the *Patella* in the Knee of a Man. In the Leg here were two Bones; the *Foſſile Majus* and *Minus*, five Inches and a half long: But this Part in the Fore-Leg was only a ſingle Bone, though in a Dog, a Monkey, and ſome other Animals, there are two Bones in the Fore-Leg likewiſe. The *Os Calcis* was almoſt two Inches long; and there were four other Bones of the *Tarſus* or Inſtep. The *Metatarſus*, or Foot, was compoſed of four Bones; and the two innermoſt much the largeſt, being two and a quarter long: there were four *Digiti*, and in each three Bones, whereof the laſt was covered with a Nail.

Explication of the Figures.

Fig.248.

Fig. 248. Repreſents the natural Shape of this *Mexico-Hog*, and the Line *a*, points to the Scene-Gland.

Fig.249.

Fig. 249. The Sceleton; *a*. the Fore-Teeth; *b*. the Tuſk; *c c*. the Grinders, or *Molares*; *d*. the Lower Jaw; *e*. that Part of the Lower Jaw which was *Carious*; *f*. the *Cranium*; *g*. the Orbit of the Eye; *h*. the *Porus Auditorius*, or Paſſage of the Ear; *i*. the Triangular Expanſion of the *Cranium* backwards; *k*. the *Vertebræ* of the Neck; *l l*. the *Vertebræ* of the Back and Loins; *m*. the *Vertebræ* of the *Os Coccygis*; *n n*. the Ribs; *o*. the Protuberant Bone of the *Sternum*; *p*. the *Scopula*, or Shoulder-Blade; *q*. the *Os Iſchii*; *r r*. the *Os Femoris*, or Thigh-Bones; *s*. the *Patella* of the hinder Legs; *t*. the *Tibia* of the Fore-Leg; *v*. a large Protuberance of the *Tibia*; *w*. the *Tibia*, or *Foſſile majus* of the hinder Leg; *x*. the *Fibula* or *Foſſile minus* of the hinder

Leg; *yy.* the *Tarſus* or Inſtep, on both Legs; *z.* the *Calx* or Heel, in the hinder Leg; *α α α.* the Bones of the *Metatarſus*, or Foot; β β β. the *Digiti* or Toes; γ γ γ. the Nails.

*Fig.*250. Fig. 250. The Orifice of the Scent-Gland, as it naturally appeared on the outſide of the Skin of the Back: A little ſpace round this Orifice was almoſt bare of Briſtles.

*Fig.*251. Fig. 251. The Scent-Gland it ſelf, which was conglomerated.

*Fig.*252. Fig. 252. Moſt of the *Viſcera*; *a.* the *Œſophagus*, or Gullet; *b.* the firſt Ventricle, or Stomach; *c.* the ſecond Ventricle, or Stomach; *d d.* the *Cornua*, or Horns of the ſecond Stomach, *e.* the third Stomach; *f.* the *Pylorus*; *g g g.* the *Inteſtina Tenuia*, or ſmall Guts; *h h h.* the *Colon*; *i.* the *Cæcum*; *k.* the *Rectum*; *l.* the Meſentery; *m m.* the Meſeraick Veſſels; *n.* the *Pancreas*; *o.* the Spleen; *p.* the Liver; *q.* the *Ductus* of the Gall, from the Liver to the *Duodenum.*

*Fig.*253. Fig. 253. The outſide of the three Stomachs, more in their natural Situation; *a.* the *Gula*; *b.* the firſt Stomach; *c.* the ſecond Stomach; *d.* the third Stomach; *e.* the *Pylorus*; *f f f.* the Blood-Veſſels.

*Fig.*254. Fig. 254. The Stomach opened; *a.* the *Œſophagus*, or *Gula*; *b.* the Entrance of the *Gula*, or Gullet into the firſt Stomach; *c c.* the inſide of the firſt Stomach, which was inveſted with a ſtrong, thick, white Pellicle or Membrane; *d d.* the ſecond Stomach; *ee.* the third Stomach, in which were remarkable ſeveral *Plicæ*, or Folds; *f.* the *Pylorus.*

*Fig.*255. Fig. 255. The Genital Parts and the Bladder; *a.* the Bladder of Urine; *b.* the Neck of the Bladder; *c c.* the *Ureters*; *d d.* the *Teſtes*; or Stones; *e e.* the *Vaſa Deferentia*; *f f.* the *Veſiculæ Seminales*, which here were Glandulous; *g.* the *Caput Gallinaginis*, where the *Veſiculæ Seminales*, and *Vaſa Deferentia* empty themſelves into the *Urethra*; *h h.* two Glandulous Bodies, which poſſibly may be reckoned the *Proſtatæ*; *i.* the Orifices, by which theſe Glandulous Bodies empty themſelves into the *Urethra*; *k.* the *Urethra* opened, *l.* the *Penis*; *m m.* the two Muſcles belonging to the *Penis*; *n n.* other Muſcles aſſiſting to the ſame.

*Fig.*256. Fig. 256. The Heart, and the *Aneuriſmata* of the *Arteria Aorta*, or great Artery; *a.* the Heart; *b b.* the Aſcending Branches of the great Artery; *c.* the deſcending Trunk of the great Artery; *d.* the firſt *Aneuriſma*, or Diſtention of the great Artery open, to ſhew its ſeveral Cells within; *e.* a ſtreightning of the Artery again; *f.* the *ſecond Aneuriſma* open likewiſe; *g.* the third or ſmalleſt *Aneuriſma*; *h h h.* the *Iliac Branches* of the great Artery.

The Anatomy of an Opoſſum, by Dr. F. Tyſon, n. 239. p. 105. *Fig.*257.

CIX. This Animal, which was brought alive from *Virginia*, has many Names given it by different Authors, and generally by the *Engliſh* it is called *Opoſſum*, or *Poſſum*. In *Latin* it is named *Semi-Vulpa*, and *Vulpi-Simia*, as if it were of a middle Nature, between a *Fox* and an *Ape*. But I think a Denomination might be beſt given it, from that particular wherein 'tis moſt diſtinguiſhable from all other Animals; which is that remarkable Pouch, or *Marſupium* it has in the Belly, into which, upon any occaſion of Danger, it can receive its young; whence it may properly be named, *Marſupiale Americanum*: And I am apt to think it may be reduced to the Vermin-kind.

It meaſured from the Extremity of the Noſe to the tip of the Tail, thirty-one Inches, the length of the Head was ſix Inches, the Tail was one Foot long, the Neck and the Body was the Complement of the firſt Dimenſion, the Girth of the Body now dead, was fifteen Inches and a half; when alive and well, it ſeemed much thicker. The Fore-Legs were ſix Inches long, the hinder Legs but four Inches and half. The Girth of the Tail, near the Root, was three Inches, near the tip but one Inch. The Head about the Ears was largeſt, meaſuring on the Fore-head, from one Ear to the other, three Inches; thence gradually tapering towards the Noſe, and more reſembling that of a *Pig* than a *Fox*. The Apertures of the Eye-lids were not Horizontal, but lying in a ſtreight Line from the Eyes to the Noſe, and not large. The Ears were about an Inch and an half long, not ſharp, but of a roundiſh Figure. The *Rictus* of her Mouth, from the corner, on one ſide, to the end of the Noſe, meaſured two Inches and a half.

The Fore-Feet had five long Claws or Fingers equally ranging with one another, and a hooked Nail at the end of each Finger. The hinder Feet had four Fingers armed with hooked Nails, and a perfect Thumb, ſet off at a diſtance from the range of the other Fingers, and as in a Human Body, this Thumb was ſhorter than the other Fingers, and had not a hooked or curved prominent Nail, but a tender flat one. This contrivance of the Legs, Feet, and Nails, ſeems very advantageous to this Animal in climbing up Trees (which it does very nimbly) for preying upon Birds, which it is moſt fond of; tho' it eats other things too. Theſe Fingers, Toes, or Claws were naked, without Hair, the Skin looking of a reddiſh Colour here.

They were about an Inch long, and the Thumbs almoſt as long. The Palms of all, eſpecially if dilated, as it does in Climbing, were large, but ſo contrived, as to be able to be contracted, as in Walking. But, that they might here be better ſecured from Injury, I find at the ſetting on of each Toe, in the Palms, a protuberant, fleſhy, and almoſt cartilaginous Body: In feeding it ſelf, it makes uſe of the Fore-Feet in bringing the Food to its Mouth; as do the *Monkey* and *Squirrel-kind*. The Tail was without Hair, (only for a little way near the ſetting on) and tapering from the Root towards the Tip, was covered with a regular Order of ſmall whitiſh Scales; which for the moſt part were oblongiſh *Hexagons*, between each of which one might obſerve a little Skin, or Membrane, in which they are fixed. The Colour of the Scales makes the Tail to appear whitiſh, tho' the Skin ſeems of a darker Colour.

The Ears were alſo bare, and without Hair: and, although ſoft and ſlender, and in colour and ſubſtance almoſt reſembling the Membrane of a *Bat*'s Wing, yet they are erect, and of an oval Figure. I could not perceive that cartilaginous Body, which uſually is to be met with in the Structure of this Part; ſo that, if it did at all enjoy a Cartilage, 'twas at leaſt much finer than in moſt other Animals. The *Concha*, or Paſſage to the *Forus Auditorius*,

torius, was very capacious. But 'twas obſerved, that, when our Subject began to grow ill, the Verge or Rime of the outward Ear ſeemed to be crimped; and when it died, to be ſo ſhrivell'd, as if burnt up, not making ſmooth, but a jagged edge.

The upper Jaw was ſomewhat longer than the under, the Noſtrils were large, the Eyes black, ſmall, vivid, and exerted, when alive; now dead, very much ſunk. The Neck was ſhort, and the Breaſt broad. It had *Muſtachio's* like a *Cat*. The Fur upon the Face was ſhorter and whiter than the reſt of the Body; on the Back and Sides it was of an *Aſh*-Colour or dappled with black Hair in ſpots, intermixt with white, eſpecially on the Back; on the Belly 'twas more of an *Amber*-Colour; and of a darker on the Legs. The longeſt Hairs, which were ſtronger and coarſer than the reſt, meaſured three Inches; being white towards the ends, but perhaps the Fur may vary in different Subjects.

Fig.258. At the bottom of the Belly, in the middle, between the two hinder Legs,
we obſerved a Slit, or Aperture, moderately extended about two Inches long;
capable of a larger Extenſion, by dilating it with one's Fingers, even when
it is alive. It can ſo exactly cloſe and contract it, that the Eye does not
Fig.259. readily diſcover it. On each ſide of this Aperture there is a Reduplication
of the Skin inwards, which forms a hairy Bag: But the Hairs here are ſo
thinly ſet, that almoſt every where you may obſerve the Skin. All Authors
agree, that the uſe of this Bag, Pouch, or *Marſupium*, is for the Preſervation
of the young Ones, and ſecuring them upon any Occaſion of
Danger; and the Deſign of Nature is admirable in forming and adapting
this Part ſo ſuitably to that End. There are two remarkable ſtrong Bones
Fig.260. not to be met with in any other Skeleton, which from their Office I take
15. 15. leave to call *Oſſa Marſupialia*, or *Janitores Marſupii*. The Bones are ſo
Fig.261. *e e*. faſtened to the upper and inward *Edge* of the *Oſſa Pubis*, that at their Baſis
here they touched one another, juſt at the Coalition of the Bones that form
the *Oſſa Pubis*: The other Extremes of theſe Bones were ſo diſtant from one
another, that it meaſured two Inches and an half. The Baſis of theſe Bones,
where joined to the *Oſſa Pubis*, was half an Inch broad, having two Heads, the
larger lying near the Coalition of the *Oſſa Pubis* and the leſſer towards the *Os
Coxendicis*; having in the Middle a *Sinus* into which was received a Protuberance
of the *Oſſa Pubis*. By this Contrivance it appears, there can be no Motion
of theſe Bones, nearer or farther from one another, but that they muſt ſtand
always at an equal Diſtance: Nor did I, upon Trial, find it otherwiſe; but obſerv'd
they were capable of a ſmall Motion inwards, towards the *Spine*, and
outwards from it. Theſe Bones, as they aſcended from the *Os Pubis*, grew
ſlenderer, being about the Middle but a quarter of an Inch broad: And they
were each two Inches, long. To theſe Bones there were beſtowed four Pair of
Muſcles, and there was another Pair that did run over them, to which theſe
Bones did perform the Office of a *Trochlea*: The firſt Pair of Muſcles (*i. e.* which
firſt came to be diſſected upon the Pronation of the Animal, and which from
its Figure I ſhall call *Triangularis*) ariſes fleſhy from the whole Length of the

internal ſide of theſe Bones, and inſerted their oppoſite Tendons on each ſide of the *Rima*, or Aperture of the *Marſupium*. Under Part of theſe Muſcles lay another, or a 2d Pair, flat and thin, having their Origin from the upper Part of the Internal Side of the *Oſſa Marſupialia*, and inſerting their oppoſite Tendons a little above the Tendons of the former Muſcles. The Tendence or Direction of the Muſcular Fibres of this Pair, in relation to the firſt, made a Decuſſation. The third Pair of Muſcles, we ſhall take Notice of, had their Riſe from the Fore-part of the Baſis of theſe Bones, where they were joined to the *Os Pubis*, and were afterwards inſerted into the *Linea Aſpera* of the Thigh-bone. The fourth Pair did ariſe from the external Side of theſe Bones near the Baſis, and are inſerted into the Fore-Part of the Thigh-Bone near the Middle. The laſt Pair of Muſcles ariſes more immediately from the *Marſupium* or Pouch it ſelf. For ſpreading their Muſcular Fibres all over this Bag, as they iſſue from it, by joining their Fibres together, they more remarkably form a Solid Muſcle, which of each Side paſſing over the middle of theſe Bones, (*i. e.* in the Prone Poſture we are diſſecting it) at length were inſerted in the Spine of the *Os Ilii*. The two firſt of theſe Muſcles muſt ſerve towards the *Dilation* or opening this *Marſupium* or Pouch; for theſe Bones are a Fulciment or Baſis; their Articulation will not admit of a Contraction inwards or nearer to one another; wherefore, when the firſt and ſecond Pair of Muſcles act or contract, they muſt neceſſarily Open or Dilate the Mouth of the *Marſupium* or Pouch. The third and fourth Pair of theſe Muſcles may ſerve to extend theſe Bones outward; ſo that, when this Animal hangs by its Tail (as it does frequently) the weight of the *Fœtus* in this Pouch, by this Means will not preſs ſo much upon the inward *Viſcera*. The fifth and laſt Pair, as they may ſerve to dilate the Capacity of the Pouch it ſelf, ſo likewiſe may ſerve the better to ſuſpend its Weight, when the Animal is *prono Capite*, and if it gravitates too much, they may retract it up; and the eaſier, becauſe, paſſing over theſe Bones like a Pulley, their Force is more augmented. The Antagoniſt to their Muſcles is the *Sphincter Marſupii*, an Oval Series of ſtrong Fleſhy Fibres, which ſerve to conſtringe and cloſe the Orifice of the Pouch; which it does ſo perfectly, (as I have already obſerved) that one would think the Skin here not to be ſlit.

Fig. 259. *A.* The Pouch, or *Marſupium* it ſelf, was a membranous Body, not very thick though conſiſting of ſeveral Coats: And is to be reduced into the Claſs of the Veſiculous Parts of the Body; which according to my Notion, are Part Muſcles, Part Glands; and do perform the Office of both Motion and Secretion. For the Concave or Hollow of this Pouch (as I have remarked) was ſomewhat Hairy, and at ſeveral Places I could obſerve them Matted or Cling'd together by a yellowiſh Subſtance, which did ouze out of the Cutaneous Glands there; as under the Arm-pits of a Man, it is obſerved.

The Liquor, thus emptied into the Pouch from the Glandulous Coat, I found was ſtrong-ſcented, and had more of the peculiar *Fœtor* of this Animal,

mal, than any Part beſides: Being no ways grateful, but unpleaſant to the Smell; as has been obſerved of this Creature when alive. But, after the Skin with the Pouch had been kept for ſome days, and was grown dry, I found ſo great an Alteration here in the Smell, that what before was ſo diſagreeable, now was become a perfect Perfume, and ſmelt altogether like *Muſk*; which made me call to Mind what formerly I had remarked of theſe Scent-Bags in other Animals. And I am apt to think that 'twas by removing this *Marſupium*, rather than taking away the Kidney, that theſe Animals are made Edible, which otherwiſe ſtink ſo much, that the Barbarous Nations refuſe them, as out of *Lerius Job. Faber* takes Notice; for I could not ſmell in the Kidneys, or Fat about them, any thing ungrateful or ill-ſcented. This *Marſupium* had likewiſe a Muſcular Coat, beſides ſeveral other Muſcles beſtowed upon it, which we have obſerved already that gave it Motion. It had likewiſe a Vaſcular Coat too, being plentifully irrigated with Blood-Veſſels; eſpecially by two large Branches, that came from the upper Part of the *Thorax*, and might be reckoned the *Mammaria*, as they are ſtiled in other Animals.

Vid. ſupra. § 168.

This Pouch was faſtened by ſeveral Membranes to the Muſcles of the *Abdomen* and the Skin, but ſo as I could ſeparate it for the moſt Part with my Fingers.

In this *Marſupium*, or Pouch, moſt Authors place the *Mammæ*, or *Teats*; and they tell very odd Stories about them: But upon what Obſervation I could make, I did not find any *Teats* here; nor indeed could I find them in the outward Skin, as uſual in other multiparous Animals.

Poſſibly this Subject never had a Litter, ſo for want of drawing they might be leſs, ſo as to eſcape our View. The Male alſo, (if we may believe *Piſo*, or the Author of the *Preſent State of his Majeſty's Territories in America*,) has ſuch another Purſe under his Belly, and takes his Turn to carry the young ones, to eaſe the Female.

This Contrivance of Nature for ſecuring the young ones from any danger, till they are able to ſhift for themſelves, I think is not to be parallel'd in any Species of Animals, at leaſt of the *Quadruped-Kind*, beſides.

Halieutic. Lib. 1.

Oppianus indeed, in his Excellent Poem of Fiſhes, tells us of the *Dog-Fiſh*, that upon any Storm, or Danger if purſued, the Young ones run into the Mothers Belly, and when the Fright and Danger is over, they come out again; he alſo inſtances the ſame Care in the *Squatina* and the *Glaucus*, tho' theſe receive their Young into different Receptacles: But if there be any Truth in theſe Stories, 'tis requiſite that it were confirm'd by more evident Proof and Obſervation.

In the *Thorax* of the *Poſſum*, I obſerved that the Lungs had three Lobes on one ſide, and but one on the other: But this One was as large as the other Three. They were ſoft and ſpongy, and eaſily dilated and large, proportionably to the Animal. The Heart was included in a *Pericardium*; as uſual, al, but the Heart itſelf I thought proportionably larger, in reſpect to the bulk of the Body, than is commonly, nor was its Cone ſo ſharp, but rather more obtuſe. It had two *Auricles* and two Ventricles. About the Throat there were large *Glandulæ Maxillares*, the Tongue was a little above three Inches long, and above three quarters of an Inch broad; 'twas rough, having Protuberances whoſe Points looked inwards; the Voice, or Noiſe it made, was a little Growling.

The *Abdomen*, or Belly, was divided from the *Thorax*, or Breaſt, by a large, ſtrong, fleſhy *Diaphragm*: For the Compaſs of the *Thorax* in this place was very great and large, which might be rendred ſo the more, by Reaſon it often hangs by its Tail, and, when it does ſo, the *Viſcera* in the *Abdomen* can't but preſs upon it.

*Fig.*263.B.8.

The Ventricle or Stomach ſomething reſembled the Figure of a Half-Moon as uſually: But the two Orifices of the *Gula* and *Pylorus* were placed ſo near one another, that they ſeemed to touch or meet; and, when I opened the Stomach, I found only a very ſlender *Iſthmus*, or Wall parted them. Theſe Orifices were inſerted almoſt in the middle of the upper part, but more inclining towards that, that reſpects the *Duodenum*. It appeared but ſmall being much contracted; for it had not eaten any thing for ſome Days; it meaſured about three Inches and half in length, and about two Inches in Depth. The *Gula*, which conveys the Food into the Stomach, conſiſted of ſtrong *Muſcular* Fibres, and was in all about nine Inches in length. The *Pylorus*, that carries out, ſeemed to have its Paſſage free and open, without that Annular Conſtriction, or Valve, as in moſt other Animals; though here we obſerved a larger Body of Muſcular Fibres, than in other Inteſtines.

Fig. 263. C.

At one ſide I obſerved a Perforation, or Hole through, about the bigneſs of an ordinary Pea, and round. That this was occaſioned by an Ulcer there, I plainly perceived by the Lips or Edges, which were not freſh; but had an ulcerated Matter about them; and this, without doubt, was the Occaſion of its Death; for it had fallen from its Food, and had pined away for ſome Time before, and by its uneaſy Motion made its Keeper ſuſpect, it had ſwallowed ſomething that ſtuck in its Throat, or injured its Stomach. A like Accident I had three times met with in the Diſſection of Human Bodies. Perhaps ſome of the Glands in the Stomach (ſuch as *Payerus* and Dr. *Grew* deſcribe in the Inteſtines (being become *Scrophulous*, or *Steatomatous*, might Impoſtumate, and ſo corrode the Coats of the Stomach, and cauſe this Perforation: And the rather I am of this Opinion, becauſe I found in other Places of the Stomach theſe Glands very large and *Steatomatous*; though naturally they are but ſmall, and often not obſerved. Where there is a Perforation of the Stomach upon an Inflammation, and upon that an Impoſtumation, there the *Foramen* is larger and not regular; as remarkably I once met with it in a Child, where a larger part of one ſide of the Stomach was ſphacelated. So likewiſe upon a Corroſive Poiſon taken, its effect dilates itſelf more, and is not confined to ſo narrow a Compaſs, as I obſerved once in one who had taken *Rats-Bane*.

De Glandul. inteſtin.

Comparative Anat. of the Stomach and Guts.

*Fig.*266. There was nothing contained in the Stomach, but a Body of Clotted Hair, formed into the Shape and Figure of the Stomach, ſomewhat like an half-Moon; covered with a ſlimy viſcid Subſtance, which did ſerve the better to glue theſe Hairs together. Theſe Hairy *Tophi* are frequently to be met with in the Stomachs of *Oxen*; and the *Butchers* inform me, that they chiefly meet with them in the Winter-Seaſon, after the Hair begins to ſhed, and the Cattle feed upon Hay or dry Meat; but after the Spring, and in Summer, they do more ſeldom find them, as if the New Graſs, which purges them, did contribute to diſſolve theſe *Tophi* likewiſe. But our Animal is Carnivorous and (in which all Accounts agree) moſt Rapacious of the Winged Kind; and, where it can't find its Prey on the Land, it will hunt for it in the Trees, moſt nimbly climbing them up; and if the tender Bough cannot bear the weight of its Body on its Feet, by twiſting its Tail about the Twig it can hang thereby, and ſtretch it ſelf the farther, to obtain its deſired Food, or rob a Neſt. Nay, if I am not miſ-informed, by this means it can fly or paſs from one Tree to another, without deſcending; for thus hanging by its Tail, and waving and ſwinging its Body like a *Pendulum*, it can fling itſelf into the Boughs of a Neighbouring Tree, where his Tail is ſure to take faſt hold of the firſt Bough it lights on, if otherwiſe it miſſes its Footing; and, as I have ſhewn, his hinder Leg being made like Hands with a Thumb, it can more readily raiſe its Body up by them. But though theſe Animals be Carnivorous, yet when Need drives them, they can take up with other Food; for this we diſſected, would eat any thing that was brought from the Table.

*Fig.*263. The *Meſentery* is that Membranous Part, which colligates the Inteſtines, and fixes their Situation, and gives to them the Order of their Figure. For the Inteſtines are not juſt faſtened to the *Periphery*, or outward Circumference of the *Meſentery*; but the outward Membrane of the *Meſentery* of both ſides is entirely projected and continued over the whole *Canalis*, or Duct of the Guts; and is to them the outward or common Membrane. So that often, by ſeparating this outward Membrane from what lies under it, the *Muſcular*, I have extracted the whole length of the Guts, leaving only the common Membrane, as 'tis continued from that of the *Meſentery*; which I could inflate, as if the whole of the Guts remained. Now here we obſerved, that remarkable Difference from what is in many other Animals, that we cannot but make two *Meſenteries*; one peculiar to the ſmall Guts, the other belonging to the great ones.

The former I ſhall call *Menſenterium Minorum*, and the latter *Meſenterium Majorum Inteſtinorum*: For, as the *Duodenum* deſcended from the Stomach, it ran under the *Colon* (juſt where 'tis joined to the *Cæcum*) towards the middle of the *Spine*. Hence I found a Projection of the firſt *Meſentery* into a Spiral Line, like a *Cochlea*, or Winding Pair of Stairs: So that upon Inflation, theſe Inteſtines here made ſeveral Convolutions, tho' not exactly *Spiral*. The ſecond *Meſentery* was projected more in a Plane; and made almoſt a Circular Figure at its Periphery: So that the *Cæcum*, and *Colon*, did almoſt entirely encircle the ſmall Guts.

The Reverſe of this Structure of the Inteſtines I formerly found in the Anatomy of the *Tajacu*; for there the *Colon* made a Spiral Figure, and the ſmall Guts made a Plane. But this Spiral Convolutions of the Inteſtines is alſo to be met with in ſeveral other Animals, though their Structure be different; as in the *Goat* and *Deer-kind*; and very remarkably in a *Woodcock*. *Vide ſupra*, §CVIII.

The ſmall Guts meaſured about ſix Feet and a half in length; the *Cæcum* was about ſix Inches; and the *Colon* and *Rectum* two Foot long. The Girth of the *Duodenum* (I mean all along here as inflated) was three Inches; the *Ilion* two Inches and a half; the Girth of the *Cæcum* in the largeſt place was ſix Inches; of the *Colon* four Inches: And the *Rectum* was three Inches about. From the *Spine* to the utmoſt Projection of the ſmall Guts, (under the ſame Circumſtance of Inflation) we meaſured about ſix Inches; the greateſt Diameter, that the *Colon* in this Circular Figure made, was ſomewhat above ſeven Inches. In the whole *Duct*, or *Canalis* of the Inteſtines, I could not obſerve any Valves, no, not in the *Cæcum* it ſelf. 'Tis true, that the *Foramen* into the *Cæcum* was a great deal leſs than the Capacity of the Gut itſelf: However, the Paſſage into it was ſo open and wide, as readily to receive or emit its Contents.

But the length and frequent Gyracions and Windings of the Inteſtines ſupply this want of Valves; they prevent the danger of a too haſty Deſcent of the *Fæces*, and gave a greater opportunity to the ſeparation of the Chyle into the *Vaſa Chylifera*. And the *Cochlea*, or Spiral Figure of the firſt *Meſentery* eaſily prevents the Regurgitation of the Contents of the Inteſtines again into the Stomach, upon a Declivity of the Body of this Animal, as it is frequently in, when it hangs by its Tail. For tho', as I obſerved, the Paſſage from the Stomach, by the *Pylorus* into the *Duodenum*, is large and open, yet in the Poſture of the Body there cannot but be a Reduplication, or folding over of the *Duodenum*; ſince the great Bulk or Wallet of theſe Inteſtines muſt incline and ſwag towards the *Diaphragm*: By which Reduplication, the Paſſage at the *Pylorus* muſt, in a great Meaſure, be occluded; and the Aſcent of the Contents now, be altogether as difficult and great, as when the Animal ſtands upon its four Feet.

The *Pancreas* was large, having one part (if I miſ-remember not) running towards the Spleen, and the other down by the *Duodenum*. The Liver was very large, of a bright red Colour, conſiſting of three Lobes, two of them were much larger than the third, which was not to be ſeen but upon inverting the Liver. And here we found not only at the edges of one of the larger Lobes, deep *Inciſures*, which rendred it jagged; but alſo in the middle of the Concave part of the ſame Lobe, ſeveral deep Fiſſures; poſſibly for this Reaſon, that ſo it might yield and give way the better, when 'tis inverted, as 'tis always, when this Animal hangs by its Tail. The Bladder of Gall was very large. The Kidneys of each ſide were a little above an Inch and half long, about three quarters of an Inch broad, and of the Figure almoſt of a *Kidney-Bean*. The emulgent Veins and Arteries were very plainly ſeen: But on the *Fig.* 267. *B B B.* *Fig.* 264. *A A.*

Inſide of the Kidneys, towards the upper part, were placed the *Glandulæ Renales*, which were very large, and of the ſame Colour with the Kidneys themſelves, which was a deep Red.

Fig. 364. *f.* The *Ureters* were about five Inches and half long, and were inſerted into the Neck of the Bladder of Urine, as is repreſented, firſt running under, then aſcending up by two Extreams of each *Uterus*, as they lie duplicated. The Bladder of Urine, being inflated, was about the bigneſs of a Hen's Egg, and of that Figure. The Neck of the Bladder, or *Urethra*, (which was about an Inch long) lay over the *Vagina Uteri*; and here the *Urethra* and the *Vagina Uteri* emptied themſelves into one common *Canalis*, or Paſſage, which meaſured about an Inch and half in length. In moſt Animals about the Kidneys there uſes to be obſerved a large Body of Fat covering them, being contained in the *Membrana Adipoſa*: But here we found four large protuberant Lumps of Fat, two of each ſide; two of them lying in the *Pelvis* of the *Abdomen*, near the Bladder of Urine, and the *Uterine* Parts, and the two others between them and the Kidneys.

They conſiſted of regular large *Laminæ*; which were eaſily ſeparable from one another, in broad Flakes, ſo as I have never obſerved before.

Fi. 264, 265. Amongſt the *Uterine* Parts, which were very ſurpriſing, we found two *Ovaria*, two *Tubæ Fallopianæ*, two *Cornua Uteri*, two *Uteri*, and two *Vaginæ Uteri*. The *Ovaria* were placed one of each ſide near the Extreams of the *Cornua Uteri*, being faſtened to the *Alæ Uteri*, and were about the bigneſs of a *Vetch*. The *Vaſa Præparantia* (the Artery and the Vein that did go to and from them) were very plain, and as I have repreſented them; though the greateſt part *Fig.* 264. of theſe Veſſels were beſtowed upon the *Cornua Uteri*. Near the *Ovaria*, I *xxx. oooo.* obſerved the *Fimbria Foliacea*, and thence a Paſſage into the *Tuba Fallopiana*. The *Tubæ Fallopianæ* were two fine ſlender *Canales* or *Ducts*, ſupported by the *Alæ Uteri*, and running waving, and led into the extreams of the *Cornua Uteri*. The *Cornua Uteri*, being inflated, were about the bigneſs of a Gooſe-Quill, about an Inch and half long; and were faſtened to the *Alæ Uteri*, towards both ends a little crooked, but where they paſs into the *Uteri*, they were reflected inwards, and at the other Extream reflected outwards. Their Subſtance ſeemed rather thicker than the *Uteri* themſelves, and not ſo tranſparent, by reaſon of the numerous Blood-Veſſels which irrigated them almoſt all over; for in the inſide, both above and under, there ran the whole length of the *Cornua*, large Trunks of Blood-Veſſels, ſending from the ſides all along numerous Branches, which is very requiſite: For in Animals that are Multiparous, as in our Subject, (having five or ſix young Ones at a time) the Litter, or *Fœtus* do lie, and are formed in the *Cornua Uteri*. And I did here take Notice, of ſome little Riſings of the inward Membrane of the *Cornua*, whereby they were ſomewhat divided into Cells, but very imperfectly. However *Fig.* 164. *xx.* for the Nouriſhment and Formation of the *Embryo's* here, ſo great a *Fig.* 265. *cc.* number of Blood-Veſſels is highly neceſſary, and they were far more numerous here than in the *Uteri* themſelves. The two *Cornua* do empty themſelves *Vide ſuprà,* § XLIII. into the two *Uteri*, juſt in the middle where they are conjoined together, and ſo outwardly ſeem to form but (as it were) one continued Body. In *Lobſters* and *Crabs*, in the Female there are two *Uteri*, as in the Male there are two *Penes*; ſo two *Penes*, and each Forked too, I have obſerved in the *Rattle-Snake*: But I think this is the only Inſtance of a *Land-Quadruped*, that has two *Uteri*; and each of theſe two, ſeemingly double by the Reflection they make, and by an imperfect Diaphragm, which divides the Cavity of each *Uterus* a conſiderable way.

Theſe *Uteri* are not faſtened to the *Alæ*, as are the *Ovaria*, *Tubæ*, and *Cornua*; but where they are conjoined near the Inſertion of the *Cornua*, they do adhere very firmly to the Neck of the Bladder, not eaſily to be ſeparated thence; and by a Membrane, to the *Rectum*, where they are more ſeparable. So that the Neck of the Bladder lies over the *Diaphragm*, or Membrane, which parted them (as I ſaid) into two diſtinct *Uteri*. Here the Body of the *Uteri* meaſur'd in Compaſs (thus inflated) was about an Inch and three quarters: Hence they were projected towards each ſide, and not according to the length of the *Spine*, gradually enlarging the inward Cavity, as 'tis extended; for here about the Angle of Reflection, if meaſur'd in Compaſs, two Inches and an half. The *Uteri* being thus extended towards each ſide about the ſpace of an Inch and three quarters, are then reflected back again towards the Neck of the Bladder, and ſo paſs into the two *Vaginæ* which lie under the *Urethra*. From this Angle of Reflection, the Cavity of each *Uterus* gradually leſſens, and is much ſmaller than the other parts of the *Uterus*; the Capacity of each *Uterus* being the largeſt at the outward Elbow, where it begins to be reflected; for here it was made, as 'twere, one common Cavity for almoſt the length of an Inch. But on the inſide, I obſerved a Membrane to be projected from the Internal ſide of the *Uteri*, juſt from the Corner where the ſides of the *Uteri* are doubled, whereby this Cavity is in part divided; and for this reaſon ſhall call the Membrane, the *Second*, or an *imperfect Diaphragm* of the *Uteri*. In theſe *Uteri* I obſerved four large Trunks of Blood-Veſſels, which did run the whole length of them, ſending from their ſides numerous Branches and Ramifications all along. Theſe Trunks were propagated from the Hypogaſtrick and Spermatick Veſſels. I did alſo here obſerve in theſe *Uteri* (this by Inflation extended and dried) ſeveral *Faſciculi* of muſcular Fibres, placed at a regular diſtance from one another; which did run the whole length of the *Uteri* likewiſe; by means of whoſe Contraction the *Fœtus* may be more eaſily forced out.

Theſe two *Uteri* empty themſelves into the two *Vaginæ*; for at this Extream, the *Uteri*, making a turn at the Neck of the Bladder, are continued thence into the two *Vaginæ*, which lie juſt under the *Urethra*, and are much of the ſame length with it, which was about an Inch. Their Capacity was about the bigneſs of a *Wheat-Straw*: Both theſe *Vaginæ*, and *Urethra* too, emptied themſelves into a common Paſſage, or *Canalis*, which was as large as all the other three, and about an Inch and half long. It looked reddiſh by means of the numerous *Blood-Veſſels* it enjoyed, and at laſt had its Exit ſo near the *Fundament*, that, when alive, there was not obſerved any other *Fora-*

men outwardly, but that which led into the *Rectum:* But when I came to diſſect it, by elevating the Skin here, which ſeemed to cover it like a Valve, I obſerved the *Foramen* that led into this common Paſſage, and putting a Blow-Pipe into it, at the ſame time by Inflation, I extended the Bladder of Urine, and the *Uterine Parts* too, *viz.* the *Vagina,* the *Uteri,* and the *Cornua.* So that in the Skin here, there was only one *Foramen* for the Exit of the *Fæces* and the *Urine* and the *Fœtus* too.

I have not had an Opportunity of diſſecting a *Male Poſſum*; and the Account we find of it in Authors is very ſhort and imperfect; ſo that Mr. *Ray,* with good Reaſon, *queries* whether the *Tai ibi* of *Braſile,* deſcribed by *Margrave,* differs from our Subject, the *Poſſum,* only in Sex.

The *Skeleton* of the *Head,* from the End of the *Occiput* to the Extream of the *Nares,* was four Inches and three quarters long, of which the *Roſtrum* meaſured three Inches, and juſt where the *Roſtrum* and the *Cranium* met, the Bones were ſo pinched in at the ſides, that here 'twas very narrow; and I may ſay, in proportion to the Bulk of the Animal, this was the leaſt *Cranium* I ever met with in a *Quadruped.* On the *Forehead,* the *Roſtrum* was an Inch broad, having on each ſide, a *Protuberance* jetting out. There was a large *Suture* juſt in the middle, which divided the upper Bones of the *Nares* lengthways; and though they run ſlender towards the Extream of the *Nares,* yet theſe Bones towards the *Forehead* ſpread into a Triangular Figure, and as they are jointed together, they form a *Rhomboid,* or a *Lozenge.* There was a remarkable riſing Ridge like a *Creſt,* that runs the length of the *Cranium,* from the *Forehead* to the *Occiput,* juſt in the middle, where the *Sutura Sagittalis* is in other Skulls. This Ridge, for Diſtinction-ſake, I ſhall call, *Protuberantia Oſſa Longitudinalis*; and I obſerved, it jutted out from the *Cranium,* above a Quarter of an Inch. Juſt at its upper Edge, I could perceive a Seam like a Suture: So that, though now theſe Bones are ſo well united together, that they appeared as one entire Body, yet in the *Fœtus,* without doubt, they are ſeparable, and are two; and this I rather think, becauſe in the upper part of the *Cranium* I could not find any Sutures at all. So likewiſe anſwerable to the *Lambdoidal Suture,* may be thoſe other Ridges in the Extream of the *Occiput,* which I ſhall call *Protuberantiæ Oſſeæ Laterales:* Which ariſing on each ſide from the *Proceſſus Styloides,* aſcend oblique up the hinder part of the *Occiput,* and juſt in the middle in the top are joined with the *Longitudinal Ridge,* I have deſcribed. Theſe Ridges, although as deep as the firſt, yet were not ſtanding ſo upright, but projected rather like a Pent-Houſe, over this hinder part of the *Cranium:* By both which Ridges, the *Cranium* is ſo well guarded and defended, that 'tis almoſt impoſſible, the Skull ſhould be any ways cracked or broken. Something like theſe Ridges, but nothing ſo large, I have obſerved in the Skull of a *Weaſel.* The Eyes likewiſe are very well guarded and defended by the *Os Zygomaticum*; which is very broad and ſtrong, in the broadeſt place being above three quarters of an Inch, and in the narroweſt half an Inch, being very thick on its under Edge, but at its upper, growing thin and ſharp. But for the greater ſtrengthning this Bone, (which is formed by a Proceſs from the *Os Temporum*, and another from the *Maxilla Superior*) where they meet, they lap over one another, and ſo become the ſtronger. This *Os Zygomaticum* was two Inches and a half long, and ſtanding off from the *Cranium* an Inch in diſtance. In the Orbit of the Eye, at the inward *Canthus*, there was a large *Foramen*, which led into the Cavity of the Noſe; and by a Duct placed here, the Tears, or Moiſture from the Eyes, are conveyed into the Noſtrils. In the upper Jaw-Bone likewiſe, there was a large *Foramen*, which was for the Paſſage of ſome Veſſels from the inward Orbit of the Eye. The *Cranium*, which encompaſſed the Brain, in the largeſt place, was about an Inch over, and about an Inch and an half in length; but its Cavity jutted out ſomewhat farther towards the *Nares*, making as it were, a particular Cell here, and pretty Capacious, for the receiving the *Proceſſus Mammillares*, and that Fore-part of the Brain. And afterwards I obſerved the *Os Cribriforme*, very remarkably perforated with Holes like a Sieve; and indeed, in forming this Organ of Smelling, Nature ſeems very careful, and ſollicitous, the *Roſtrum* making ſo great a part of the Head, that the *Cranium* it ſelf ſeemed very inconſiderable in reſpect to it, its inward Capacity containing not above the Quantity of a Walnut. The *Os Spongioſum* in each Noſtril ſeemed very Curiouſly contrived by the abundance of *Lamina* it enjoys, ſo that the Membrane that covers them, by this means, is rendred more Capacious, and capable of receiving more plentifully the *Effluvia*'s of thoſe Animals, it would either Catch, or Avoid: And in this Senſory 'tis known that Brutes excel even Man himſelf, and their Organ is more Adapted for it.

The under Jaw conſiſteth of two ſtrong Bones, joined together only at the *Mentum*, each meaſured four Inches in length. The Head of this Bone (which was half an Inch broad) was received into a *Sinus* of the *Os Temporum*, and very firmly *Articulated* there. It had two *Proceſſus*, the Anterior or Superior is large and thin, into which is inſerted the *Temporal Muſcle*: The *Inferior Proceſſus* is ſmaller, and runs to a ſharp Point. Here at this Proceſs, the Edge of the *Mandible* is ſo dilated, that it meaſured above half an Inch. On the inſide of the Jaw there is a large *Sinus*, which leads to a *Foramen* that goes into the Body of the Jaw-Bone, and affords a Paſſage for the Veſſels thither. In the upper Jaw before were eight ſmall *Dentes Inciſores*, four of each ſide; then a Void Space, a quarter of an Inch, then two large Prominent *Dentes Canini*, one of each ſide, which jutted out of the Jaw about half an Inch; theſe were ſucceeded on each ſide, with three *Dentes Inciſores*: But theſe were much ſtronger and larger than the Fore-Teeth, and imitated the *Dentes Molares*, were flat and almoſt of a Triangular Figure; there were four *Dentes Molares*, on each ſide, in all 24 Teeth in the upper Jaw. But the Double Fangs of the *Molares*, and the *Inciſores Majores*, were ſuch as at the firſt Sight, one would think two Diſtinct Teeth, each Fang being inſerted into a Diſtinct *Alveolus*, or Socket, in the Jaw, and remaining ſeparated ſome way above the Jaw-Bone, and only joined at the Head. In the under Jaw-Bone, there were likewiſe of each ſide, four *Dentes Inciſores Minores* before, then a little

Void Space, after that the *Dens Caninus*, then three *Dentes Inciſores Majores*,
and laſt of all four *Dentes Molares*, anſwerable to thoſe in the upper Jaw, but
ſomewhat ſmaller. In both Jaws, in all 48 Teeth.

There were ſeven *Vertebræ* of the Neck, 13 of the Back or *Thorax*, 6 of the
Loins, 3 of the *Os Sacrum*, and 22 of the Tail, 51 in all. The *firſt Vertebræ*
Fig. 268. of the Neck, (to which the Head is faſtened, and is therefore call'd the *Atlas*)
had two broad *Tranſverſe Proceſſes*, but no *Spine*. The 2d *Vertebra* of
the Neck had a very large and thick Spine of a Triangular Figure: And in
it was obſerved a large Semi-circular *Sinus*, which was ſo deep as to receive
Fig. 368. *d.* into its Boſom a great part of the Firſt *Vertebra*, by which means the Articulation
was very much ſtrengthned. This *Vertebra* is called *Dentata*, from
that Tooth like Protuberance I have repreſented, and which is receiv'd into
the Hollow of the Firſt *Vertebra*, where the *Medulla Spinalis* runs. This
Vertebra backwards, had two *Proceſſus obliqui ſuperiores*, and two *Obliqui*
Fig. 269. *inferiores*. The 3d *Vertebra* of the Neck, had the ſame Proceſſes both before
and behind, but the Spine here was about three quarters of an Inch in height,
about the 3d part of an Inch thick, and juſt at the top ſeemed to be a little
Cleft. The 4th and 5th *Vertebræ* had the ſame Proceſſes, as the 3d *Vertebra*,
and the Spine here likewiſe was very thick and cleft to the top, but gradually
leſſening in height, as alſo thickning. The 6th *Vertebra*, beſides the former
Proceſſes, had likewiſe an Acute Tranſverſe one on each ſide, and its Spine
much ſhorter and more acuminated than the former. The 7th *Vertebra*
of the Neck had only Oblique Proceſſes before, and none behind, and two
Acute Tranſverſe Proceſſes, and a very ſhort and ſharp Spine: So that upon
holding up the Head, the Spine of the firſt *Vertebra* of the *Thorax* would touch
the top of the 5th *Vertebra* of the Neck. Theſe *Vertebræ* are ſo ſtrongly and
cloſely locked into one another, that tho' each of them are large in themſelves;
yet thus articulated, they do not make full two Inches in length. This Thickneſs
and Strength of the *Vertebræ* of the Neck, and likewiſe of ſeveral of the
Vertebræ of the *Thorax* and Loins, and the prominent bony Ridge in the *Cranium*,
ſo well ſecure his Neck, Back, and Head, that ſhould it happen to fall
to the Ground, there would be no Danger of breaking any of them.

*Fig.*270. The firſt ſeven *Vertebræ* of the *Thorax*, have three Oblique Proceſſes forwards,
which run under the hinder Oblique Proceſſes of the preceding *Vertebra*,
and have two oblique Proceſſes backwards, which ride over thoſe of the
ſucceeding *Vertebra*; as likewiſe two *tranſverſe Proceſſes*, which at their Ends
have ſmall *Acetabula*'s or *Sinus*'s, for the receiving the Heads of the Ribs,
which are faſtened to them. The Spines of theſe *Vertebræ* are ſlender, thin, and
ſharp, about three quarters of an Inch long. The ſix following *Vertebræ* of the
Thorax, have ſhort, thick, and flat Spines, the oblique Proceſſes being continued
on each Side of the Spine, make, as 'twere a *Gutter*; and the *tranſverſe Proceſſes*
here, are ſomewhat different from the former. The Spines of the *Vertebræ*
*Fig.*271. of the Back, or Loins, the more they approached the *Os ſacrum*, ſo they leſſened
gradually in their Thickneſs on the Edge. But here were double oblique
Proceſſes, *viz.* four at each end of the *Vertebra*, and the undermoſt ſpreading

themſelves out broad. The three *Vertebræ* of the *Os ſacrum*, are firmly faſtened to the *Os Ilium*, but the laſt not ſo entirely as the two former. But this at each ſide had a broad tranſverſe Proceſs, and the Spines of theſe were thin; the two firſt *Vertebræ* of the Tail, had only one ſmall acute Spine, but in all the other *Vertebræ* of the Tail, both at the *Head* and Tail of each *Vertebra*, I obſerved two Spines, but thoſe at the Head of the Joint the larger. In the ſix firſt *Vertebræ* of the Tail, there was on each Side, a broad tranſverſe Proceſs, the length of the Joint; in the other *Vertebræ*, only at the Head and Tail, a Jutting out at the ſides. The *Vertebræ* about the middle of the Tail, were the longeſt; being there about an Inch long; the Root of the Tail, and at the End, not ſo long.

*Fig.*272. The Spines or Hooks, placed in a Line in the Middle of the Under-ſide of the *Vertebræ* of the Tail, are a wonderful Piece of Nature's Mechaniſm. 'Tis true, the firſt three *Vertebræ* had none of theſe Spines, but in all the reſt they were to be obſerved; but as they approached the extremity of the Tail, they grew leſſer and ſhorter; theſe Spines, where longeſt, were about a quarter of an Inch, or ſomewhat more. They were placed juſt at the Articulation of each Joint, and in the middle from the Sides, and ſeemed to be articulated, both to the preceding and following *Vertebræ*, not being an entire ſolid Body, but ariſing from the *Vertebræ* with two Legs or *Crura*, become afterwards perfectly united to the Ends. By this means, the Bones are rendred more firm and ſtrong, and this Hollow ſerves for the tranſmitting of the Blood-Veſſels through them; and one may obſerve here a *Stria*, or Furrow, all the Length of the *Vertebræ*, for the receiving them, whereby they are the better ſecured from Compreſſion, when this Animal hangs by its Tail. And for the performing this Office, nothing, I think, could be more advantageouſly contrived: For when the Tail is twirled or wound about a Stick, this Hook of the Spine eaſily ſuſtains the Weight, and there is but little Labour of the Muſcles required; only enough for the Bowing or Crooking the Tail; for then, as by a Hook, the Weight of the whole Body is hereby ſuſpended. And for the doing this, 'twas obſerved, that in each preceding *Vertebra*, there did a Muſcle ariſe, which was inſerted on each ſide of the ſucceeding *Vertebra*; which Acting, or Contracting, muſt neceſſarily bend and curve that Joint. But for the ſtrengthning the whole, there were obſerved four Muſcles to ariſe from the *Os ſacrum*, which did run the whole length of the Tail; two on the upper ſide, and two on the under, ſounding each a Tendon to each *Internode* or *Vertebra*. So that when the Skin was ſtript off, the outward Parts of theſe Muſcles ſeemed to have tendinous Expanſions over them, the whole length of the Tail, and almoſt to be covered by them, which muſt needs very much contribute and add Strength to the Tail; beſides what may be the Effect of their Inſertion of Tendons into each Joint, or *Vertebra*, in *curling* and unbending the Tail.

*Fig.*266. To the *Vertebræ* of the *Thorax* are faſtened the Ribs, and there are 13 on each Side. The ſeven Foremoſt are more perfectly *articulated* with the *Sternum*, the ſix ſucceeding may be reckoned, in ſome ſenſe, *Coſtæ Nothæ*: For, though they are long, and as they proceed from the *Vertebræ*, are inclined backwards towards the hinder Legs, yet afterwards they are reflected forwards towards the *Sternum* or *Cartilago Scutiformis*. And though in other Animals, that Part of the Ribs that is faſtened to the *Os Pectoris*, or *Sternum*, be uſually Cartilaginous, yet here, in our Subject, I obſerved it to be all Bony throughout. However, this Difference I found, that the Ribs did look redder, by reaſon of the Blood-Veſſels in them, and this Part was whiter, as where it was faſtened to the Ribs one might plainly ſee; ſo that it may well paſs for a Bony Cartilage, as often the Cartilages do become Bony.

The firſt Rib was only an Inch long, and its bony Cartilage a quarter of an Inch: Hence gradually the Ribs increaſe in length, for the 7th Rib was three Inches long, and its Cartilage was one Inch and a half. The four laſt of the *Coſtæ Nothæ*, gradually leſſen again in length; for the laſt Rib of all was only an Inch and three quarters long; and its Cartilage did not run home to the *Os Pectoris*, or *Sternum*, tho' the firſt, ſecond, and third, of the *Coſtæ Nothæ* did. The *Os Pectoris*, or *Sternum*, conſiſted of ſeven Bones, according to the Number of the Fore-Ribs that are faſtened to them. At the beginning of the *Sternum*, there jutted out a ſharp bony Cartilage, which, from its Figure I ſhall call *Cartilago Enſiformis*: And here was faſtened one extream of the *Cavicula*. At the End of the *Sternum*, towards the Belly there was a broad, roundiſh *Cartilage*, which therefore I ſhall call *Cartilago Scutiformis*.

There were two *Claviculæ* or Collar-Bones, each an Inch and half long, having one Extream faſtened to the firſt Bone of the *Sternum*, or the *Cartilago Enſiformis*, and the other End to the Spine or *Scapula*, near the Conjunction of it to the *Os Humeri*. By means of this Bone, it can more advantageouſly bring its Fore-feet to its Mouth, as it uſes to do when it feeds itſelf, as do the Monkey-kind, who have *Claviculæ* too as well as Man; tho' many Animals want theſe Bones.

Fig.262. The *Scapula*, or Shoulder-Blade, was about two Inches long, and about an Inch and half broad; its *Spine*, tho' thin, yet the nearer it approached the Shoulder, it grew larger and flatter. Into the *Sinus* of the Neck of the *Scapula*, was received the Head of the Shoulder-Bone, or Fore-Thigh-Bone, and to that Protuberance called the *Acromium* was faſtened the End of the *Clavicula*. This Thigh-Bone of the fore Legs, was about two Inches three quarters long, 'twas thick and ſtrong, having a large rough Spine jutting forward and running half the length of it. The lower Extream of this Thigh-Bone, to which was faſtened the *Tibia* and *Fibula*, grew very broad, being almoſt an Inch broad. Above where this Bone began to grow broad, on the outſide was a large Protuberance, and on the inſide there was a great oblong *Foramen*, or hollow Paſſage, formed by a ſmall Bone ariſing from the inward Fore-part of the Thigh-bone, where it began to grow larger, and was afterwards united to that part of the Baſis of this Bone, where the *Fibula*, or *Minus focile* is joined. Juſt in the middle of the Baſis of this Bone, there was a large *Sinus* which backwards appeared deeper, which did look into another deep *Sinus* of the *Tibia*, by which means theſe Bones were ſo firmly articulated together, as they

were not eaſily, if poſſibly to be put out of Joint. The *Tibia*, or *Focile majus*, was a ſtrong Bone about two Inches long, which was extended upwards above a quarter of an Inch above its Articulation with the Thigh-Bone, and at the other end was faſtened to the outward Bone of the *Tarſus*. The *Fibula*, or *Focile minus*, was a ſmaller Bone, placed more inwardly and forwarder, and not ſo long as the *Tibia*, being Articulated above, (but not ſo firmly) with the Thigh-Bone, and below, with the inward Bone of the *Tarſus*; for there were but two Bones of the *Tarſus*, having each a ſmall *Sinus*, for the receiving the Heads of the *Fociles*. The Bones of the *Metatarſus*, were four, or it may be five; to which were joined four Fingers or Toes of the fore Feet. The innermoſt Toe had but two Articulations, or Joints, but at the end had a large hooked, ſtrong Nail; the other four Fingers had each three *Articuli*, or Joints, armed with hooked Nails, as the firſt.

The hinder Legs were faſtened to the Trunk of the Body by the *Os Innominatum*; which in the whole in a ſtreight Line was three Inches long. In the Head of the hinder Thigh-Bone, and deeper in, there was a ſpace for the faſtening the Ligament, from which ſpace there was a *Sinus* which led outward; ſo that the Brims of the *Acetabulum* were not an entire Circle, but broken off here. *Fig.263.*

Here alſo are the *Oſſa marſupialia*, or *Janitores Marſupii*. The hinder Thigh-Bone was a little above three Inches long, 'twas roundiſh and a ſtrong Bone: But the *Tibia*, or *Majus Focile* of the hinder Leg, was ſomewhat longer, a little curv'd. The *Fibula*, or *Minus Focile*, was about the ſame length ſtreighter and ſlenderer. This towards the Foot was articulated to the *Os Calcis*, as the *Tibia* was to the *Talus*, or *Aſtragalus*; and theſe two Bodies I make the *Tarſus*; and joining to them were the Bones of the *Metatarſus*, and to theſe the *Phalanges* of the Fingers and Toes. In the innermoſt, or the Thumb, there were only two *Articuli*, or Bones, in the other four Toes, or *Digiti*, in each there were two *Articuli*, or Joints. The end of the Thumb was more flatted than the ends of the other Toes: For the Thumb, as I have obſerved, had a flat Nail like a Human Thumb: In the others, the Nails were long and curved. I obſerved likewiſe at the Articulation of each Joint of the Toes, on the under ſide there were two ſmall Bones, that are called *Oſſa Seſamoidea*, and theſe both in the fore and hinder Feet.

Explanation of the Figures

Fig. 257. Repreſents the *Poſſum* drawn from the Life. *Fig.257.*

Fig. 258. The Slit, or *Aperture* in the Belly, that goes to the *Marſupium*, or Pouch. *Fig.258.*

Fig. 259. *A.* the *Marſupium* turned the inſide outwards, where may be obſerved the Hair or Fur that covers it, and may help the better to keep the young Ones warm. *B B.* the two hinder Legs cut off. *C.* the *Foramen* of the *Anus:* Which is alſo the common outward Vent, or *Exit*, the *Rectum*, the Bladder of Urine, and the *Uteri* too. *D*, the beginning of the Tail. *Fig.259.*

Fig. 260. The *Skeleton*. *A A.* the *Roſtrum*, or Snout; *b b.* the *Cranium*, or Skull, that did contain the Brain; *ccc.* a bony Ridge, or *Protuberantia Oſſea Longitudinalis*, that did run the length of the *Cranium*, and over a part of the *Fig.260.*

Roſtrum; *d.* the lateral Ridge, which like a Pent-houſe, jutted over the hinder part of the *Cranium*, *Protuberantia Oſſea Lateralis*; *e f.* the *Os Zygomaticum*; *e.* its Proceſs from the *Os Temporum*; and *f.* that from the *Maxilla ſuperior*, open Jaw; *g.* a *Foramen*, or Hole, in the inward *Canthus* of the Orbit of the Eye, that leads into the Noſtrils, and by a *Duct* conveys the Tears, or Moiſture of the Eyes into them; *h.* a *Foramen*, or Hole in the upper Jaw, for a Paſſage to the Veſſels; *i.* a Protuberance of the *Os Frontis*; *K.* a Suture of the *Os Narium*; *l l.* the lower *Mandible*, or Jaw-Bone, *Maxilla inferior*; *m.* the ſuperior Proceſs of the under Jaw; *n.* the inferior Proceſs of the under Jaw; *o.* the *Clavicula* of one Side; *p.* the *Cartilago Enſiformis* of the firſt Bone of the *Sternum*; *q.* the *Scapula*, or Shoulder-Blade-Bone; *r.* the Spine of the *Scapula*; *S S S S.* the Thigh-Bones of all the Feet; *T T T T.* the *Tibia*, or *Foſcile majus* of all the Feet; *u u.* part of the *Tibia* in the Fore-Legs extended beyond Articulation; *W W W W.* the *Fibula*, or *Foſcile minus*, in all the Legs; *x x x x.* the Bones of the *Tarſus*; *y y y y.* the Bones in the *Metatarſus*; *z z z z.* the Toes; *a a.* the Thumbs in the hinder Feet. 1. The firſt *Vertebræ* of the Neck, called the *Atlas*; 2. 3. 4. 5. 6. 7. the 2*d*, 3*d*, 4*th*, 5*th*, 6*th*, and 7*th Vertebræ* of the Neck; 8. the firſt *Vertebra* of the *Thorax*; 9. the firſt *Vertebra* of the Loins; 10. the firſt *Vertebra* of the *Os ſacrum*; 11. the firſt *Vertebra* of the *Os Coxygis*; or Tail, 12, 12, 12, 12. the Spines, or Hooks, on the inſide of the Tail; 13. 14. the *Os Innominatum*; where 13 is the *Os Ilium*; 14. the *Os Iſchii*, or *Coxendicis*; 15. 15. the *Oſſa marſupialia* ſeu *Janitores Marſupii*; * * * *. the Ribs, thirteen in all, ⊙ the *Cartilago ſcutiformis*.

*Fig.*261. Fig. 261. The Situation of the *Oſſa Marſupialia*, &c. *a a.* the *Oſſa Pubis*; *b.* the *Coalition*, or the joining of the *Oſſa Pubis*; *c c.* the *two Oſſa Marſupialia*, or *Janitores Marſupii*; *d. e.* the Baſis of the *Oſſa Marſupialia*, where joined to the *Oſſa Pubis*; *d.* the *Inward Head* of the *Baſis*; *e.* the *Outward*; *f f.* the *Acetabulum*, or Socket, for receiving the *Head* of the *Thigh-Bone*; *g g.* the *Os Ilium*; *h h.* the *Vertebræ* of the *Os Sacrum*; *i i.* the *Os Iſchii*, or *Coxendicis.*

*Fig.*262. Fig. 262. The fore-ſide of the Thigh-Bone of the Fore-Leg; *a.* the Head of the Thigh-Bone, where it is faſtened to the *Scapula*; *b.* a large rough *Spine*, which runs above half the length of this Thigh-Bone; *c.* a Protuberance of this Bone on the outſide; *d.* a large *Foramen*, or Hollow Paſſage; *e.* a *Sinus* for receiving the Head of the *Tibia*; *f g.* the *Baſis*, or lower Extream of the Thigh-Bone.

*Fig.*263. Fig. 263. The Stomach, and Guts; *A.* the *Gula*; *B B.* the Stomach; *c.* a Perforation of the Stomach cauſed by an Ulcer there; *d d.* the two Pouchings out of the Stomach at the two Ends; *e.* the *Pylorus*; *f.* the beginning of the *Duodenum*; *g h i K L M N o p q.* repreſent the ſmall Guts, and the Coyles and Convolutions they do make; ſome of the Coyles lie hid, and out of Sight: But the Order how they follow one another is ſignified by the Order of the Letters of the Alphabet; ſo that *g*, follows *f*; and *g*, is ſucceeded by *i*; and *i*, by *K*; and ſo on to *q*; where the *Ilion* is diſcharged and emptied into the *Cæcum*, or, if that is full; into the *Colon*, at the firſt Letter

S, *R*, *R*, the *Cæcum*; *S S S*, the *Colon*; *T*. the *Rectum*; *V*. the *firſt Meſentery*, or *Meſenterium minorum Inteſtinorum*; *w*. the *ſecond Meſentery*, or *Meſenterium majorum Inteſtinorum*.

Fig.264. Fig. 264. The *Urinary*, and *Uterine Parts*; *A A*. the two Kidneys; *b b*. the *Emulgent Veins*; *c c*. the *Emulgent Arteries*; *d d*. the *Glandulæ Renales*; *e e*. the *two Ureters*; *f*. the Inſertion of the *left Ureter* into the *Neck* of the *Bladder*; *G*. the *Bladder* of *Urine*, turn'd aſide; *h*. the *Urethra*; *ii*. the *two Vaginæ Uteri*; *K*. the *common Paſſage* from the *Urethra*, and the *two Vaginæ*; *l*. the *Arteria Aorta*, or *great Artery*; *m*. the *Vena Cava*; *n n n*. the *Spermatick Arteries*; *o o o o*. the *Spermatick Veins*; *p p p*. the *Hypogaſtrick Arteries and Veins*; *r r r*. the *Alæ Uteri*, *ſeu potius Cornuum*; *S S*. the *Ovaria*; *t t*. the *Tubæ Fallopianæ*; *u u*. the *Uteri* of the *Left Side opened*; *w*. the *Cornu Uteri* of the *Right Side not opened*; *x x*. the *two Uteri opened*; *y*. the *Diaphragm* that divides the *two Uteri*; *z z*. the *Imperfect Diaphragm*, which partly divides each *Uterus*, and lies over the Paſſage of that part of the *Uterus*, which is doubled and tends to the *Vaginæ*.

Fig.265. Fig. 265. The *Uterine Parts* more particularly; *A A*. the *two Ovaria*; *b b*. the *Fimbria Foliacea*; *c c*. the *Tubæ Fallopianæ*; *d d*. the *two Cornua Uteri*; *EE*. the *two Uteri* reduplicated; *f*. a *Slit* in the *Neck* of its *left Uterus* to ſhew its Paſſage in the *Vaginæ* on that ſide; *g*. the *Left Vagina opened*; *h*. the *Oſtium*, or *Mouth*, of the *right Vagina*; *i*. the *Common Paſſage* from the *Urethra* and *Vagina*; *K*. the *Urethra*; *l l*. the *Bladder* of *Urine* cut off.

Fig.266. Fig. 266. The *Hairy Tophus*.

Fig.267. Fig. 267. The *Liver*; *A*. the *Vena Cava*; *B B B*; the *three Lobes* of the *Liver*; *C*. the Bladder of *Gall*; *d d d*. the *Fiſſures* of the Body of the *Liver*; *e e e*. the *Inciſures* at the Edges of the *Liver*.

Fig.268. Fig. 268. *A*. the *Spine* of the 2d *Vertebra* of the *Neck*; *b*. repreſents its Thickneſs; *c*. a large *Sinus* for receiving the *firſt Vertebra*; *d*. the *Dens*, or Tooth of this *Vertebra*; the *Proceſſus Obliquus Superior* of one Side; *f*. the *Proceſſus Obliquus inferior* of the ſame Side.

Fig.269. Fig. 269. *A*. the *Spine* of the 3d *Vertebra* of the *Neck*, where is ſhewn its natural Thickneſs; *b*. the *Hole* through which the *Medulla Spinalis* paſſes; *c c*. two ſmall *Foramina* for the Paſſage of the *Veſſels*; *d*. repreſents the *Cleft* at the top of the *Spine*; *e e*. the *two Proceſſus Obliqui Superiores* before; *f f*. the *two Proceſſus Obliqui Inferiores* before.

Fig.270. Fig. 270. The *firſt Vertebra* of the *Thorax*; *A*. the *Spine*, which is long and acute; *b b*. the *Oblique Proceſſes* before; *c c*. the *Oblique Proceſſes* behind; *d d*. the *Tranſverſe Proceſſes*; *e e*. where the Ribs are faſtened; *f*. the *Hollow* where the *Medulla Spinalis* paſſes.

Fig.271. Fig. 271. The 4th *Vertebra* of the *Loins*; *a a*. the *two upper Oblique Proceſſes* behind; *b*. the *Spine*; *c c*. the *two under Oblique Proceſſes* behind.

Fig.272. Fig. 272. The 2d and 3d *Vertebræ* of the *Tail*; *a a*. *two Vertebræ* of the *Tail*; *b b b*. the *Spines*, or *Hooks* on the Inſide, by means of which it can better hang by its *Tail*; *c c*. a *Hollow*, or *Foramen*, in the middle of theſe *Spines*, through which *Blood-Veſſels* paſs.

CX.

A monſtrous double Turkey, by Sir J. Floyer, n. 259. p. 434

CX. At *Thorpe*, in *Staffordſhire*, two young *Turkeys*, were taken out of an Egg (of the Ordinary ſize) when the reſt of the Eggs were well hatched, which grew together by the Fleſh of the Breaſt-Bone, but were in all other Parts diſtinct. They ſeemed leſs than the ordinary thickneſs of *Turkeys*: For there wanted both Nutriment and Room for their Growth; which was the occaſion of their Coheſion and Smallneſs. They had diſtinct Cavities in their Bodies, and two Hearts; ſo that they had two diſtinct *Cicatricula's*, and conſequently the Egg had two Yolks in it, from whence they were produced; which Accident is very common. But I have a dried monſtrous Chicken which had but one Head, four Wings, four Legs, and one Cavity in the Body, and conſequently had but one Heart. In this Caſe this monſtrous Chicken was produced from one *Cicatricula*. So *Paræus* mentions a double Infant with one Heart. In theſe Caſes the Original of the Infant was one, and the Veſſels regular; but in the Extremity the *Arteries* and *Nerves* were divided into more Branches than ordinary, and produced double Parts. And thus it is like the double Flowers of Plants, which are produced ſo by the Richneſs of the Soil. And thus it is in the Eggs of *Quadrupeds*; they are joined in the *Ovarium*, and as they grow their Bodies do externally *Cohere*. So that I may obſerve, that there are theſe two Reaſons of the Multitude of the Parts in an *Embryo*; the joining of two perfect Animals, or elſe the extraordinary Diviſion of the *Original Veſſels*, the *Arteries* and *Nerves*.

A Monſtrous Colt; *by Mr.* R. Boyle, n. 5. p. 85.

Fig. 273.

CXI. The Body of this *Colt* appeared to the Eye compleatly Formed, without any Monſtroſity to be taken Notice of in it: But the Head being opened, and examin'd, it was found, that it had no Sign of any Noſe in the uſual Place. The two Eyes were united into one double Eye, which was placed juſt in the middle of the Crow, the Noſe being wanting which ſhould have ſeparated them: Whereby the two Eye-Holes in the Skull were united into one very large round Hole, into the midſt of which, from the Brain, entered one pretty large Optick Nerve, at the End of which grew a great Double Eye; that is, that Membrane, called *Scelerotis*, which contained both, was one and the ſame, but ſeemed to have a Seam, by which they were joined, to go quite round it, and the fore or pellucid Part was diſtinctly ſeparated into two *Corneas*, by a white Seam that divided them. Each *Cornea* ſeem'd to have its *Iris*, (or *Rainbow*-like Circle) and Apertures, or Pupils, diſtinct, and upon opening the *Cornea* there were found within it two Balls, or Chryſtalline Humours, very well ſhaped. The Eye-Lids were alſo a little divided in the middle. Juſt above the Eyes, as it were in the midſt of the Forehead, was a very deep Depreſſion, and out of the midſt of that grew a kind of double Purſe or Bag, containing little or nothing in it: But to ſome it ſeemed to be a Production of the matter deſigned for the Noſe, but diverted by this Monſtrous Conception; perhaps the *Proceſſus Mammillares* joined into one, and were covered with a thin Hairy Skin.

CXII. A Butcher (at *Limmington* in *Hampſhire*) having killed a fatted Cow, and opening the Womb found in it a Monſtrous Calf, which begun to have Hair. The Feet of this Calf were ſo parted, as to be like the Claws of a Dog; the Legs had no Joints; and the Tongue was, *Cerberus*-like, Triple, to each ſide of his Mouth one, and one in the midſt. Between the Fore-Legs and the Hinder-Legs was a great Stone, on which the *Calf* rid. The Skin of the Breaſt, and between the Legs, and of the Neck (which Parts lay on the ſmaller End of the Stone) was much thicker than on any other Part. The Stone (which was bigger at one End than the other) weighed 20 Pounds and half, the outſide was of a greeniſh Clour; and not plain, but full of little Cavities; when broke it appeared full of ſmall Pebble-Stones, of an *Oval Figure*; its Colour gray like Free-ſtone, but intermixt with Veins of Yellow and Black.

A Monſtrous Calf, *by Mr.* Dav. Thomas, *n.* 1. *p.* 10. *n.* 2. *p.* 20.

CXIII. *Jan.* 11. 1677-8, A Cow of Mr. *Will. Dabs*'s, at *Milnecoat* in *Warwickſhire*, brought forth a Monſtrous Calf, having one perfect large Head; and on the right Side of that grew another, almoſt as large, and of true Shape, having both Tongue and Teeth; and from the Roof of the Mouth of the Monſtrous Head hung down a piece of Fleſh with the ſhape of a Tongue upon it, and a row of Teeth, as on an under Jaw: Which occaſioned the Man who ſhewed it, to ſay that it had three Mouths. It had to each Head two Eyes, only thoſe of the Monſtrous were very ſmall, and I believe had no Sight. It had only two Ears to both Heads, one of which was placed on the farſide of the Monſtrous Head, the other as uſual in other Calves. It *Breathed* equally at both Mouths, and had communicated with the ſame Throat, but took its Nouriſhment only at the Perfect Mouth, the under Jaw of the other being ſo weak, that the Mouth always ſtood open and drivell'd. It appeared on the left ſide to be a perfect Calf, and looked very lively, and was at three Days Old, as large and ſtrong as other Calves uſually are at 10 Days, or a Fortnight.

A Monſtrous Calf *with two Heads*; *by Sir* Rob. Southwel, *n.* 238. *p.* 79.

CXIV. *Feb.* 24, 1666-7. *Rob. Cloak*, of *Beer-Ferris* in *Devonſhire*, had a *Black Ram-Lamb* fallen with one Head, but two diſtinct Bodies, with eight Legs, which Bodies were joined in the Neck. It had two Eyes, and as many Ears, in the uſual Places; and one Extraordinary Eye in the *Niddock*, with one ſingle Ear, about an Inch diſtant from the Eye backwards. Its Dam uſually brought forth two Lambs every Year, as ſhe did this Year alſo; which with the Ewe remain alive; but this Monſter was found dead by the Hedge.

About the ſame time, *John Cauce*, of the ſame Pariſh, had a *White Lamb* fallen, with two diſtinct Heads and Necks, joined at the Shoulders, but one only Body; and that well formed, yet having double Entrails in all reſpects. The Ewe remains well, but the Monſter dy'd.

Two Monſtrous Lambs, *by Mr.* Colepreſs, *n.* 26. *p.* 480.

A Monſtrous Pig, *by* . . . *n.* 147. *p.* 188.

CXV. In *December* 1682, Among many Pigs of a *Sow*, there was one which had no Paſſage for the *Fæces*, either Solid or Liquid, although the *Anus* was not outwardly cloſed up; and being diſſected, we found the Guts very much diſtended and tranſparent, and through them appeared the *Fæces* very Liquid, accompanied with no ſmall quantity of Wind. The End of the *Rectum* was entirely cloſed like a Bladder, and ſealed as it were, Hermetically, Pendulous in the Cavity, and not in the leaſt continued to a *Sphincter*, of which there was no Sign. There was no Bladder to be found, nor *Uterus*, nor any Mark of what Sex it was deſigned for: But both the Ureters were Inſerted into the *Rectum*, within an Inch, or thereabouts of the End. The Stomach was full, even to Diſtention, of an Hard Subſtance, which appeared exactly the ſame with hard preſs'd Curds. The Chyle came freely enough out of the *Ductus Peequelitanus*, where it was inſerted into the Jugular, upon the preſſure of the Inteſtines: But I could not urge the Liquid or Flatulent Contents of the Guts upwards, within two Inches of the *Pylorus*, tho' I preſſed them till they crack'd.

Two Monſtrous Pigs, *by Sir* J. Floyer, *n.* 359 *p.* 431.

CXVI. In *May* 1699, There was ſhewed to me a Pig at *Weedford* in *Staffordſhire*, with a Face ſomething repreſenting that of a Man's, and the Chin was very like that of an Human *Fœtus*. But, when I had well conſidered the Head, I obſerved there was a Depreſſion of the Bones of the Noſe, in that Place which was betwixt the Eyes, in which the Pig's Face ſeemed to me to be broken, and the Noſe drawn up to appear like an Human. The under Jaw was Inverted, to grow up to meet the upper; the Tongue and Mouth were made more like an Human, being altered by ſome External Preſſure upon the Mouth of the Pig, which broke the Bones of the Noſe, and cauſed their Depreſſion towards the Palate, and the Inverſion of the under Jaw. This Preſſure on the Mouth forced the Bones upward, ſo much as to cover the Eye-Holes, and the Pig appears Blind. *A.* is the Place of the Bone depreſſed; *B.* is the Depth of it. It cloſed itſelf with a Spring, when we opened it by Force; ſo that it had grown cloſed up, ever ſince it was Cartilaginous. By this Breach, or Depreſſion of the Pig's Face, I was firſt convinced, that this Monſter was not produced by the Copulation of two Species, as was uſually apprehended, but only occaſioned by the Perverſion of the Compreſſion of the Womb, or *Placenta*, or other Pigs in the ſame Part of the *Womb*. And that the Pig's Head was ſtreightned in its Growth appeared by the Flatneſs of the Ears, and that this Depreſſure happen'd whilſt the Bones were Cartilaginous, appears by the Bones depreſſed, which remain'd Cartilaginous, and at the ſame time the under Jaw was Inverted, and the Head made more round. I farther obſerved, that all the Head was covered with Hair, as the other Pigs were; that the Teeth in the Mouth were Pig's Teeth; the Hair of the Pig's Head was Yellow, as that of the Sow was; the Monſtrous Pig was as big, and as well

Grown as the reſt of the Pigs, and therefore begot by the Boar at the ſame Time; the Noſe was a Perfect Pig's Snout, and there was no upper Lip, as in the Human Kind. In all the other Parts, it appeared to be a Perfect Pig; no Parts were wanting, but thoſe of the Face, diſtorted by ſome External Accident. At the beginning of the 17th Week, from that Time when the Sow took the Boar which is the uſual Time, the Sow Pigg'd eight Pigs, the firſt five were Perfect Pigs, the Sixth was the Monſter, and after that two more Perfect Pigs. This Monſter was Pigg'd Alive, but died becauſe it could not Suck, the Noſe being Stopped. The Cry of the Pig was not like the other Pigs, becauſe of the Stoppage of its Noſe, and the Alteration of the Figure of its Mouth.

This Kind of Monſtrous Pigs, produced by the Unnatural Situation of Parts, by ſome External Compreſſion, I believe is very frequent; becauſe I had another of the ſame kind, ſent me out of *Derbyſhire*, which had a Reſemblance of a Man's Face, and all the other Parts of a Pig, and this had the ſame Chin, and Depreſſion betwixt the Eyes, the Roundneſs of the Head, and Flatneſs of the Ears, I have above deſcribed. But this *Derbyſhire*-Monſter wanted Hair, as Pigs which come too ſoon do; and no Sex could be diſtinguiſhed in it: But the former deſcribed was a *Boar-Pig*.

The Anatomy of a Monſtrous double Cat, by Dr. Mullen, n. 174. *p.* 1135.

Fig. 275.

CXVII. This Monſtrous Catling was Dead when I met with it, and I am perſuaded that it was ſo brought forth, the Lungs being Compact and free from Air, which they could not be, if it had ever Inſpired. It was Double from the Navel downwards, having four Hind-feet, two Tails, two Anus's, and two *Pudenda*; for they were Females. They were jointed into one Trunk at the Navel, and were continued ſo upwards: But yet this Monſter had two Pair of *Fore-feet*, one of them on the Back, and the other on the Breaſt. The Head, though ſingle, had two Pair of Ears, one naturally ſeated, and another at the hinder part of the Head, between the *Proceſſus Mammillares*, to which the *Vertebræ* of both the Necks where joined.

There was only one Stomach under the Liver in the Right-ſide, reaching under another Liver in the left. The Guts were ſingle till within ſix or ſeven Inches of the *Anus*, and there was a Diviſion into two Branches, one going to each Fundament; below the Diviſion there were plainly to be ſeen two *Cæcums*, within about three Inches of the *Anus* each. There were two Livers, one much ſmaller than the other, that which was in the Right-ſide was the leaſt, the other lay lower, down in the left-ſide, they were both entire without any Diviſion or Lobes. There was a *Vena Umbilicalis* inſerted into each of them. There were *two Arteries* inſerted into the Liver in the left-ſide, both coming from the *Aorta*, and theſe I ſhall call the *Cæliacæ*; but there was only one inſerted into the Liver placed in the right-ſide. There was no *Vena Cava* below the Livers; for all the Veins coming from the lower parts entred the Livers as the *Vena Porta* does naturally. There was a Branch of a Vein on each ſide proceeding from the Loins, inſerted into the Back Parts of the Liver: and beſides theſe there was not a Branch to be ſeen, but what was inſerted into the middle of the Livers. There were two Kidneys on each ſide furniſhed with Ureters. There was neither *Spleen* nor *Pancreas* in either ſide.

There was a Double Diaphragm meeting in the middle between the two Back-Bones, and making a Membrane, which to me ſeemed to be a *Mediaſtinum*, for it reached up to the *Thymus*. There were two Hearts in it, one placed above the other, and a little to the Right-ſide, it was much higher than ordinary, and it had a Vein coming to it from the little Liver in the Right-ſide, which (together with three other ſmall Veins, one from each of the *Fore Feet*, and one from the Head) furniſhed this Heart with what Blood was to be circulated by it. It had only one Auricle, and one Ventricle: So that it ſeemed to be but half a Heart. There was a pretty large Paſſage into the *Arteria Aorta*, the Contrivance of which was very ſingular; for above this Heart it was made like an Arch of a Circle, into which there was a direct Paſſage from the Heart for the Blood. When I further examined this Artery, I found that it went down on each ſide on the *Vertebræ* of the Backs between the Kidneys, and divided it ſelf on each ſide after the uſual manner, after it had lent each Kidney a Branch, the Liver in the Right-ſide one, and the Liver in the Left ſide two. Below the former, a little towards the Left ſide of it, there was another half Heart, having only one Auricle and one Ventricle like the former. This received little Blood but what was tranſmitted from the large Liver in the Left ſide, by that that is call'd the *Truncus Aſcendens* of the *Vena Cava*. The Artery carrying the Blood from this Heart was inſerted into the Artery lately deſcrib'd, as well as that of the other Heart. So that, if the Blood circulated through either of them, the whole Animal muſt neceſſarily be ſupplied with Blood, a Contrivance not unlike that of the Arteries under the Brain, where the *Arteriæ Carotides* and *Vertebrales* do empty themſelves into one Common Channel, from which all Parts of the Brain may eaſily be ſupplied with Blood.

*Fig.*278. The Head was joined to two Necks about the *Proceſſus Mammillares*.

*Fig.*279. There were four Orders of *Ribs*, though the Body was but one above the *Navel*.

Explication of the Figures.

*Fig.*275. Fig. 275. Expreſſes to the Life the outward Shape, when placed on its Back.

*Fig.*276. Fig. 276. The *Cat opened*. 1. the *Stomach*, pull'd from behind both the *Livers*, ſo as to be plainly ſeen; 2. the beginning of the Guts below the *Pylorus*; 3. the Diviſion of the Gut into two Branches, whereof one went to each *Anus*; 4. 4. the *two Cæcums*; 5. 5. 5. 5. the two pair of *Kidneys*, furniſhed with *emulgent Arteries* and *Veins*; 6. a *large Liver* in the *left Side*, much lower ſituated than the *Liver* in the *right Side*; 7. the *Liver* in the *right Side*, with a *Vein*; 8. coming from the *Kidneys* of the ſame Side, after it had united above the *Emulgents*; this ſupplies the Office of the *Vena Cava*.

and *Vena Porta*; 9. 9. two large Branches of the big *Atery* going into the Body of the big *Liver*; 10. 10. 10. 10. the *great Artery*, ſupplying both ſides with Blood, and receiving of it from the two *Hearts*; 11. the *Vein*, bringing the Blood from the lower Parts of the left Side into the *Liver*; 6. of the ſame ſide; 12. 12. the big *Artery*, ſending Branches to each of the *Kidneys*; 13. the *upper Heart*; 14. the *Artery* that ſupplied the Head with Blood; 15. 15. the *Axillary Arteries*; 16. the *Vena Cava* coming from the *Liver* in the right Side to the Heart; 13. 17. the Paſſage from the ſaid Heart to the *Aorta*.

Fig.277.

Fig. 277. 1. The *Liver* in the left Side, freed from all things that kept it any way out of Sight; 2. the *Vena Cava* paſſing from it to the lower *Heart*; 6. 3. a Skirt of the *Diaphragm* turned to the left Side, that the former Vein ſhould better appear; 4. the *Stomach*, diſplaced for the former Reaſon; 5. 5. 5. 5. the *Kidneys*; 6. the lower *Heart*, in its due Situation; 7. the upper *Heart*, drawn out of its place upwards, that the other, 6. with the Paſſage 11, from it to the *Aorta*; 9. 9. might be well repreſented; 8. 8. the *Liver* in the right Side, doubl'd and turn'd over the *Heart*; 6. that it might be the better ſet forth; 9. 9. 9. the *Aorta*, where it is not hid by the Parts diſplay'd for the former Reaſon; 10. the *Lungs* not well repreſented; 11. the Paſſage from the lower *Heart* into the *Aorta*.

Fig.278.

Fig. 278. The Skull opened, and freed from the Brain; 1. 1. the Hollows, through which the *Medulla Oblongata* was continued to the *Medulla Spinalis*, 2. 2. the two Necks.

Fig.279.

Fig. 279. 1. 1. The *Two Diaphagms* ſeparated from the *Cartilages* of the Ribs, that their *Junctures* may be ſeen; 2. 2. 2. 2. the *Vertebræ* of both the Backs; 3. 3. 3. 3. 3. 3. the *Junctures* of the two Setts of Ribs that were at the Back; 4. 4. 4. 4. the two Setts of Ribs that were joined to the Breaſt; 5. the Tips of the *Diaphragms*, pull'd downwards to ſhew the Ribs plainly; 6. 6. the *Vertebræ* of the two *Necks*.

An Animal reſembling a Whelp voided per Anum, *by a Male* Greyhound; *by Mr.* Edm. Halley, *n.* 222. *p.* 316.

CXVIII. The Account you had from *Cheſter*, in 1695, of a *Greyhound-Dog* that voided an Animal, reſembling a *Whelp*, *per Anum*, as ſtrange and incredible as it may ſeem, is yet here ſtedfaſtly believed; and the Creature was kept for ſome time in *Spirit of Wine*, having lived for ſome ſhort time after it came into the World, and it was ſeen alive by Mr. *Roberts* of the *Society*, then in *Cheſter*. They ſay, it exactly reſembled a *Grey-hound-Whelp*, and had on its Side a large Spot, in the ſame place, as the Dog it proceeded from had ſuch another; and that with it was Voided a whitiſh Mucous Matter, ſo that the People here at *Cheſter*, will not permit me to Queſtion the *Truth* thereof.

A Bitch with Puppy, tho' ſhe has loſt the Spleen; *by* —— 105. *p.* 117.

CXIX. 'Tis notorious all over *London*, that divers Years ſince, a *Bitch*, yet alive, of a conſiderable *Nobleman*, after ſhe had loſt her *Spleen*, hath been ſeveral times with Puppies; of which ſome out of Curioſity were opened, and found to have a very *fair Spleen.* *Vid.* Diemerbroeck *de Anat. Corp. Hum.*

A Cow with Four Calves, *by Sir* J. Floyer, *n.* 259, *p.* 435. CXX. I am informed, that this Year, 1699, at *Dunchurch* in *Warwickſhire*, a *Cow* calved *four Calves*, perfectly, and all Living.

A Hen with a Perfect Chick in the Ovarium, *by* — *n.* 50. *p.* 1019. CXXI. About two or three Years ſince, there was a *Hen* at *Wackton* in *Norfolk*, which being big with Eggs, upon ſome account could not Lay, but after a time died; and then being opened, there was found in the *Ovarium* a *perfect Chick*.

An Egg found within another Egg, by — *n.* 230. *p.* 632. CXXII. In *France* a ſmall Egg of about *ſeven Lines* from End to End, and four and a half of bigneſs, was found *Included* in a *Hen's Egg*, which appeared to have nothing Extraordinary on its outſide. The *ſmall Egg-ſhell* was faſtened to the *Shell of the greater* by one of its Extremities.

Ova *found in a* Cow, *by* ———, *n.*74.*p.*2218. CXXIII. There hath been very lately made, by two Phyſicians at *Paris*, a Diſſection of a *Cow*, *in the Teſticles of which there were found Eggs, as* Kerkringius *ſays he had obſerved, in his* Anthropogeniæ Ichnographia.

The Ova, *after a 2d* Conception, *diſperſed in the* Abdomen *of a Bitch, tho' the* Cornua Uteri *were filled with the Bones and Fleſh of a former* Conception, *by*-- *n.*147.*p.*183 CXXIV. The Sagacious *Harvey*, after many *repeated Diſſections of Impregnated Deer*, aſſerts, that nothing for about *ſix or ſeven Weeks* can be ſeen in the Horns of their *Wombs*; that there appeared ſomewhat like an *Egg*, a tranſparent Liquor included in a very thin *Membrane*, in which after a *Week* he could plainly *ſee the Rudiments* of a *Fœtus*. He is well ſatisfy'd (after ſeveral Trials) that no Liquor can be ſo forcibly injected into the Womb as to make its *Paſſage* into the Place of *Conception:* Nor would he ſuſpect that *the Seed of the Female* lay till the *Egg* appear'd, in any *Crannies* or *Receſſes* of the *Horns*; which he aſſerts, are then as ſmooth and ſoft, as the *Corpus Calloſum* of the *Brain*. After Dr. *Harvey* had thus ſufficiently confuted the Opinion of the Production of Animals from the mixture of the ſeminal Matter of both Sexes, 'twas not ſo difficult to diſcover whence the Egg came, which he ſaw about *ſeven Weeks* after Impregnation. The *Fallopian Tubes*, which join to the Horns, and terminate very near the *Ovaria* (as the *Teſtes muliebres*, are generally now call'd) directed the ingenious and induſtrious *de Graaff*, to make more accurate Diſſections of them: And he has ſo very nicely obſerv'd the Progreſs of the Eggs in *Conies*, the very time of their paſſing into the Tubes, and appearing in the Horns of the Womb, (which comes very near that proportion of time Dr. *Harvey* obſerved the Eggs in his Deer) that the Opinion of the Production of all Animals from Eggs is now almoſt univerſally received.

Some time ſince indeed, the learned *Diemerbroeck*, and very lately Mr. *Verney*, have endeavoured to confute this Opinion and expoſe it. The moſt conſiderable Argument they uſe, is taken from the narrowneſs of the *Fallo-*

pian

Fig. 261.

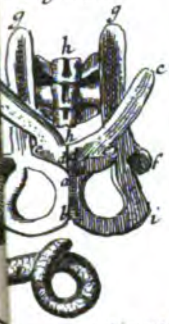


Fig. 258.

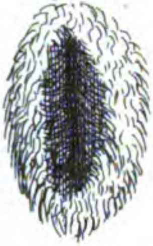


Fig. 279.

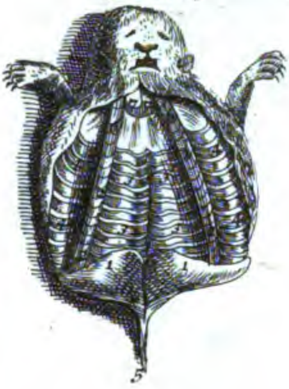


Fig. 259

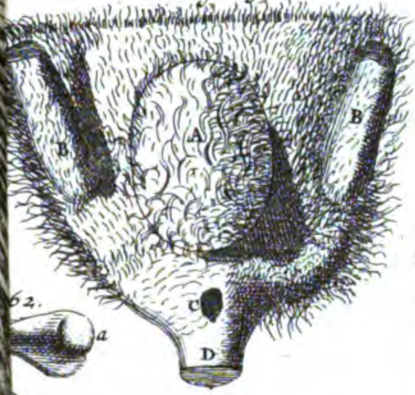
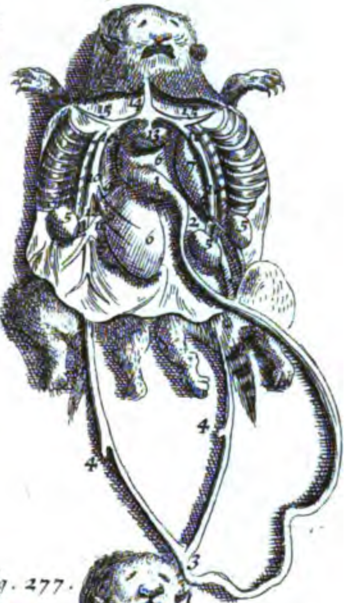


Fig. 276.



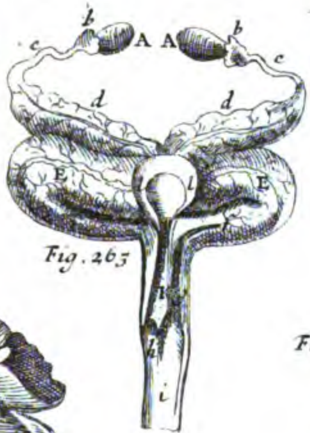
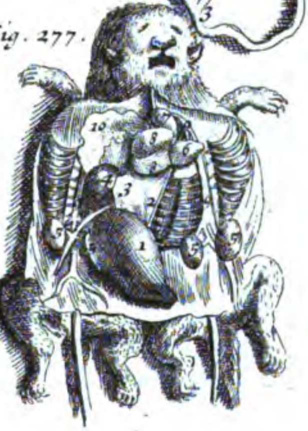


Fig. 263

Fig. 277.



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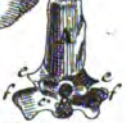

Fig. 269.

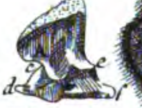

Fig. 268

Vol.
4 §.
&c.

A Cow
Four C
by Sir
Floyer,
259, *p.*
A Hen
a Perf
Chick i
Ovariu
—— *n.*
p. 101

An Eg
found
another
by ——
230. *p*

Ova f
in a C
by ——
n.74. *p*

The C
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ception
n.147.

pian Tubes, where they open into the Womb, and at their Extremities. But Dr. *de Graaff* prevented this Objection, by alledging, that the Hole by which it has its Exit out of the *Ovarium* is as narrow; that no Force is uſed to open it, but it expands itſelf as the *Os Uteri* before the Birth: As Nuts and Peach-ſtones, *&c.* give way to a germinating Plant, which is leſs able to make its way than the Egg. But beſides which, theſe Authors urge, tho' the Extremity of the Tube be membranous in moſt *Quadrupeds*, in which it's poſſible a ſeminal Liquor might be tranſmitted into the Womb; in Women it's divided like a Knot of Ribbon, and is no more adapted to receive any thing but an Egg, than the Fingers expanding to receive and contain a Fluid. The Egg has not been able ſometimes to get into the Womb; *Riolanus* ſpeaks of a human *Fœtus* ſeen in one of the Tubes, and Dr. *Harvey* aſſures you he has ſeen it himſelf.

Vid. inf. Vol. III. Cap. 4. §. CVIII. *&c.*

In the Diſſection of a *Bitch* at *Oxford*, it was obſerv'd, that the *Embryo's* either could not get into the Womb, the membranous Expanſion being hindered from aſcending to and clipping the *Ovaria*, by the fulneſs of the Womb, or from the ſame Cauſe are forc'd back again. She had been with Whelps; by a Blow ſhe received the *Fœtus*'s died within her. She diſcharged by the *Pudendum* a great Quantity of putrid Fleſh and Matter. She was afterward able to run in the Pack. After the ſecond Impregnation ſhe was obſerved to have a very ill-ſhaped Belly; when dead, the Owner, a Perſon of Quality, ſent her to *Oxford*. The Horns of the Womb were ſo ſtuft up with the Bones and firmer Muſcles, and thicker Skin of the *Fœtus*'s, (ſome of them lay in the uſual Poſture, the Skeletons of which were entire, the Interſtices of the Bones only fill'd up with Skin and Fleſh) that no ſeminal Matter, or *Aura ſeminalis* could poſſibly find a Paſſage to the *Ovarium*. The Eggs affected in the 2d Impregnation, finding no room in the *Horns*, were forc'd back into the *Abdomen*; where they were found affixt to the Meſentery, Kidney, *&c.* Only two of the Bags had a Communication with the Womb by a ſlender Duct. Theſe, I ſuppoſe, fell into the Horns firſt, and began to faſten to them, but growing larger, were forced to retire. The other three had no Reception there at all. The Membranes which contained the *Embryo*'s were all of them very thin, and the *Animalcules* in them had wanted a due ſupply of Nutritious Matter. This ſeems to give as clear a Proof of the Truth of the modern Opinion, as can be expected or deſired.

But if Anatomy had not diſcovered Eggs, and demonſtrated their Uſe and Progreſs to the Womb, it would be very difficult to conceive how an Animal could be produced from the mixture of the ſeminal Liquors of both Sexes. Every Animal (tho' upon other Accounts eſteemed the moſt deſpicable) is made up of ſo many different Parts, and thoſe of ſo excellent a Contrivance, and ſo wonderful a Reſpect to one another, that 'tis not to be imagined that the Seminal Fluids lying looſe, and at large in the Capacity of the Womb, and expoſed to ſo many Accidents, could give a Production ſo admirable. Every jog of it from the frequent Motions of the Female would diſturb and diſtract the preſent Deſigns of the Plaſtick Power they ſpeak of. The Humours and Vapours which have a Paſſage to, and humect all the Parts of the body, would in the Womb break in on the ſoft Seminal Maſs, and Break off the tender Filaments when firſt a-Forming. In *Quadrupeds* the periſtaltick Motion of the Horns would perpetually ſeparate the Parts of the ſeminal Collection, and ſcatter thoſe Pieces, which Nature is putting carefully together into the Fabrick of an Animal. From this Way of Conception, Monſters would be very frequently brought forth, and would be much leſs wondred at, than a perfect Production is now. We ſee how very induſtrious Nature is in preſerving the Species of Vegetables. When the tender Seed is firſt Formed, it is ſecured from external Injuries by various ſorts of Caſes. The *Embryo* of the Plant contained in the Seed hath three or four Coats to encloſe it; the outermoſt is deſigned of ſufficient Strength to preſerve it. None of the Juices of the Earth are permitted to enter in, but ſuch as are fit to put into Motion, or ſupply the Liquor contained in the inner Membrane, from whence it has its firſt Increaſe. And, as the Eggs of Animals are deſigned for the ſame Purpoſe the Seeds of Vegetables are, ſo there is very great Agreeableneſs between them. The Shells and Membranes of Eggs (except thoſe which are brought to Perfection in the Female Sex) are very like thoſe of Seeds; both have a *Colliquamentum*, or more fine and ſpirituous Liquor, which is firſt to be ſpent before thoſe which are groſſer can be received in the extreamly fine and ſmall Pores of the *Fœtus*, when only juſt begun to be Formed; and in both the Parts of the *Embryo* are deſigned and drawn out, before the Egg has been at all affected by the *Maſculine Seed*, or the *Vegetable Seed* put into the Womb of the Earth. The Figure of the Plant may be ſeen in the larger Seeds, and Miniature of a *Chick* in the ſpot of the Yolk.

But, if ſo great and ſo various an Artifice is neceſſary to raiſe a Plant, ſhall Nature be thought leſs careful and induſtrious in the Propagation of Animals, whoſe Parts are more numerous, and of a much finer Texture? And, ſince thoſe Animals and Vegetables are by ſome allowed to take their Original from Eggs and Seeds, whoſe largeneſs will permit them to obſerve them, it ſeems an Opinion with too much Precipitancy taken up, that ſuppoſes ſome of the greater Animals, and the leaſt of theſe, and Plants, are ſupplied from equivocal Generation; that corrupted Matter from the warmth of the Air, or the motions of its own Principles, can form the Parts of the one or the other. For the Heat of the Air endeavours to diſſipate and remove the thinner Parts from the more groſs: Since no Membrane is ſuppoſed to confine them. And the more active Principles are from their own Nature always ſtruggling to be quit of them. And this way the parts of an Animal would be ſooner broken into pieces, than a new one generated.

But they believe it may be allowed, that the leaſt and moſt inconſiderable Animal and Plants are this way Formed. But their Minuteneſs makes the Difficulty greater: A Membrane to include the Conception with its firſt Nouriſhment ſeems more neceſſary here, where the Parts are more delicately put together, and from their exceeding Fineneſs, might more eaſily miſcarry. But if after this Method ſome Animals and Plants can be produced, why is the ſame Species and theſe very Individuals they ſuppoſe ſo made, furniſhed with Organs for Univocal Generation? If Slime and Mud can afford Frogs and Eels, why does the firſt ſpawn ſo many Eggs, and are the other Viviparous? Why does not ſo great a Diverſity of putrid Parts in the Earth, differently affected by unaccountable Accidents, often preſent us with new Living Creatures, and Vegetables of peculiar Species? But no ſuch new Plants are taken Notice of, and the *Mites* are of the ſame ſort from Cheeſe and from Meal. The Objection which is offered againſt *Epicurus* will be made with the ſame Force againſt this Opinion: If the Earth at firſt equivocally produced Men, Quadrupeds, Birds, and Fiſh, why has it not done it very frequently, or, at leaſt, ſome Times ſince? We begin to ſuſpect the Cheat, when the Artiſt is not able to perform the ſame again.

The modern Theory of Generation, by Dr. Geo. Garden. *n.* 192. *p.* 474.

CXXV. 1. Upon comparing the Obſervations and Diſcoveries of Dr. *Harvey*, S. *Malpighi*, Dr. *de Graaff*, and M. *Leewenhoeck*, with one another, theſe three things ſeem to me very probable. 1. That Animals are *ex Animalculo*. 2. That the Animalcules are originally *in Semine Marium & non in Fœminis*. 3. That they can never come forward, nor be formed into *Animals* of the reſpective Kind, without the *Ova in Fœminis*.

The firſt of theſe ſeems probable from theſe three Obſervations; 1. That ſome ſuch thing has been ſo often obſerved by *Malpighius* in the *Cicatricula* of an Egg before Incubation, as the Rudiments of an Animal in the Shape of a Tadpole, as may be ſeen in his firſt, and in his repeated Obſervations, *de Formatione Pulli in Ovo*. 2. The ſudden Appearance and Diſplaying of all the Parts, after Incubation, makes it probable, that they are not then actually formed out of a Fluid, but that the *Stamina* of them have been formerly there exiſtent, and are now expanded. The firſt Part of the *Chick* which is diſcovered with the naked Eye is, you know, the *Punctum Saliens*, and that not till three Days and Nights of Incubation be paſt; and then on the fifth Day the Rudiments of the Head and Body do appear. This made Dr. *Harvey* conclude, that the Blood had a Being before any other Part of the Body, and that from it all the Organs of the *Fœtus* were both form'd and nouriſh'd; but by *Malpighius*'s Obſervations we find, that the Parts are then only ſo far extended, as to be made viſible to the naked Eye, and that they were actually exiſtent before, and diſcernible by Glaſſes. After an Incubation of 30 Hours, are to be ſeen the Head, the Eyes, and the *Carina*, with the *Vertebræ*, diſtinct, and the Heart. After 40 Hours its Pulſe is viſible, and all the other Parts more diſtinct, which cannot be diſcern'd by the naked Eye before the beginning of the fifth Day; from whence it ſeems very probable, that even the ſo early Diſcovery of thoſe Parts of the *Fœtus* by the Microſcope, is not the diſcerning of Parts newly form'd, but only more dilated and extended, by receiving of Nutriment from the *Colliquamentum*; ſo that they ſeem all to have been actually exiſtent before the Incubation of the Hen. And what *Swammerdam* has diſcover'd in the Tranſmutation of Inſects, gives no ſmall Light to this, whilſt he makes appear in the Explanation in the 13th *Table* of the *General Hiſtory of Inſects*, that in thoſe large *Eruca*'s which feed upon *Cabbage*, if they be taken about the time they retire to be transform'd into *Aurelia*'s, and plung'd often in warm Water, to make a Rupture of the Outer Skin, you will diſcern through the Tranſparency of their ſecond Membrane, all the Parts of the *Butterfly*, the Trunk, Wings, Feelers, *&c.* folded up: But that after the *Eruca* is chang'd into an *Aurelia*, none of theſe Parts can be diſcern'd, they are ſo drench'd with Moiſture, though they be there actually form'd.

Another Conſideration is from the Analogy, which we may ſuppoſe, between *Plants* and *Animals*. All *Vegetables* we ſee, do proceed *ex Plantula*, the Seeds of *Vegetables* being nothing elſe but little *Plants* of the ſame kind, folded up in Coats and Membranes; and from hence we may probably conjecture, that ſo curiouſly an Organiz'd Creature as an Animal, is not the ſudden Product of a Fluid, or *Colliquamentum*, but does much rather proceed from an Animalcule of the ſame Kind, and has all its little Members folded up, according to their ſeveral Joints and Plicatures, which are afterwards enlarg'd and diſtended, as we ſee in *Plants*. Now, though this Conſideration alone may ſeem not to bear much weight; yet being join'd to the two former, they do mutually ſtrengthen each other. And indeed, all the Laws of Motions which are as yet diſcover'd, can give but a very lame Account of the Forming of a *Plant* or *Animal*. We ſee how wretchedly *Des Cartes* came off, when he began to apply them to this Subject. They are form'd by Laws yet unknown to Mankind; and it ſeems moſt probable, the *Stamina* of all the *Plants* and *Animals* that have been, or ever ſhall be in the World, have been form'd *ab Origine Mundi*, by the Almighty Creator, within the firſt of each reſpective Kind. And he who conſiders the Nature of *Viſion*, that it does not give us the true Magnitude, but the Proportion of Things; and that which ſeems to our naked Eye but a Point, may truly be made up of as many parts as ſeem to us to be in the whole viſible World, will not think this an abſurd or impoſſible thing.

But the ſecond Thing, which later Diſcoveries have made probable, is, that theſe *Animalcules* are originally *in Semine Marium, & non in Fœminis*: And this I collect from theſe Conſiderations:

1. That there are innumerable *Animalcula in ſemine Maſculo omnium Animalium*. M. *Leewenboeck* has made this ſo evident by ſo many Obſervations, that I do not in the leaſt queſtion the Truth of the Thing.

2. The obſerving of the Rudiments of the *Fœtus* in Eggs, which have been fœcundated by the Male, and the ſeeing no ſuch Thing in thoſe which are

not fœcundated, as appears by *Malpighius* his Obſervations, makes it very probable, that theſe Rudiments proceeded originally from the Male, and not from the Female.

3. The Reſemblance between the Rudiments of the *Fœtus in Ovo*, both before and after Incubation, and the *Animalcule*, makes it very probable that they are one and the ſame. The ſame Shape and Figure which M. *Leewenhoeck* gives us of the *Animalcule*, *Malpighius* likewiſe gives us of the Rudiments of the *Fœtus*, both before and after Incubation; yea, and even the *Fœtus's* of Animals, do appear ſo at firſt to the naked Eye, ſo that Dr. *Harvey* does acknowledge that all Animals, even the moſt perfect, are begotten of a Worm. *De Gen. Anim. Ex. 18.*

4. This gives a rational Account of many *Fœtus's* at one Birth, eſpecially that of the Counteſs of *Holland*, and how at leaſt a whole Cluſter of Eggs in a Hen are fœcundated by one Coition of the Male.

5. This gives a new Light as it were to the Firſt *Prophecy* concerning the *Meſſiah*, that *the Seed of the Woman ſhall bruiſe the Head of the Serpent*: All the reſt of Mankind being thus moſt properly and truly the Seed of the Man.

6. The Analogy I have already mentioned, which we may rationally ſuppoſe between the Manner of Propagation of Plants and Animals, does likewiſe make this probable. Every Herb and Tree bears its Seed after its Kind; which Seed is nothing elſe but a little Plant of the ſame Kind, which being thrown into the Earth, as into its *Uterus*, ſpreads forth its Roots, and receives its Nouriſhment, but has its Form within itſelf; and we may rationally conjecture ſome ſuch Analogy in the Propagation of *Animals*.

The 3d particular which later Diſcoveries make probable, is, That *Animals* cannot be formed of theſe *Animalcula* without the *Ova in Fœminis*, which are neceſſary for ſupplying of them with proper Nutriment; and this theſe Conſiderations ſeem to evince. 1. It is probable that an Animalcule cannot come forward, if it do not fall into a proper *Nidus*. This we ſee is the *Cicatricula* in Eggs; and tho' a Million of them ſhould fall into one Egg, none of them would come forward, but what were in the Centre of the *Cicatricula*; and perhaps the *Nidus*, neceſſary for their Formation, is ſo proportioned to their Bulk, that it can hardly contain more than one Animalcule; and this may be the Reaſon why there are ſo few Monſters. This, we ſee, is abſolutely neceſſary *in Oviparis*; and the only Difference, which ſeems to be between them and the *Vivipara* in this matter, is in this, that in the latter the *Ova* are properly Nothing more but the *Cicatricula*, with its *Colliquamentum*, ſo that the *Fœtus*, muſt ſpread forth its Roots into the *Uterus* to receive its Nouriſhment; but the Eggs, *in Oviparis* may be properly termed an *Uterus* in Relation to the *Fœtus*; for they contain, not only the *Cicatricula* with its *Amnion* and the *Colliquamentum*, which is the immediate Nouriſhment of the *Fœtus*, but alſo the Materials which are to be converted into that *Colliquamentum*, ſo that the *Fœtus* ſpreads forth its Roots no farther than into the White and Yolk of the Egg, from whence it derives all its Nouriſhment. Now that an *Animalcule* cannot come forward without ſome ſuch proper *Nidus*, M. *Leewenhoeck* will not readily deny; for if there were nothing needful but their being thrown into the *Uterus*, I do not ſee why many Hundreds of them ſhould not come forward at once, at leaſt whilſt ſcatter'd in ſo large a Field.

Vid. Inf. Vol. III. *cap.* IV. § CXII. & CIX. Now, 2. That this *Cicatricula* is not originally *in Utero*, ſeems evident from the frequent Conceptions which have been found *extra Uterum*; ſuch as the Child which continued 26 Years in the Woman of *Thoulouſe's* Belly; and the Little *Fœtus* found in the *Abdomen* of Mad. *de S. Mere*, together with the *Teſticle* torn and full of clotted Blood; ſuch alſo ſeem to be the *Fœtus* in the *Abdomen* of the Woman of *Copenhagen*, mentioned in the *Nouvelles des Lettres*, for *Sep.* 85. all the Members of which were eaſily to be felt thro' the Skin of the Belly, and which ſhe had carried in her Belly for four Years: And the ſeven Years Gravidation related by Dr. *Cole*. *Vid. Inf. Vol.* III. *cap.* IV. § CXVII. Now granting once the Neceſſity of a proper *Nidus*, for the Formation of an *Animalcule* into the Animal of its reſpective Kind, theſe Obſervations make it probable, that the *Teſtes* are the *Ovaria* appropriated for this Uſe; for though the *Animalcules* coming thither in ſuch Caſes, may ſeem to be extraordinary, and that uſually the Impregnation is *in Utero*, yet it may be collected from hence, that the *Cicraticulæ* or *Ova* to be Impregnated, are *Teſtibus Fœmineis*; for if it were not ſo, the accidental coming of *Animalcules* thither could not make them come forward more than in any other Part of the Body, ſince they cannot be Formed and Nouriſhed without a proper *Nidus*.

But 3. It is acknowledged by all, that the *Fœtus in Utero*, for ſome conſiderable Time after Conception, has no *Connexion* with the *Womb*; that it ſits wholly looſe to it; and is perfectly a little round Egg with the *Fœtus* in the midſt, which ſends forth its Umbilical Veſſels by Degrees, and at laſt lays hold on the *Uterus*. Now from hence it ſeems evident, that the *Cicatricula*, which is the Fountain of the Animalcule's Nouriſhment, does not ſprout from the *Uterus*, but it has its Origin elſewhere, and falls in thither as into a fit Soil, from whence it may draw *Nutriment* for the Growth of the *Fœtus*; elſe it cannot be eaſily imagined how it ſhould not have an immediate Connexion with the *Uterus* from the Time of Conception.

If you join all theſe three Conſiderations together, *viz.* That an *Animalcule* cannot come forward without a proper *Nidus*, or *Cicatricula*; that there have been frequent *Fœtus's extra Uterum*; and that they have no Adheſion to the *Uterus* for a conſiderable time after Conception; they ſeem to make it evident, that Animals cannot be formed *ex Animalculis* without the *Ova in Fœminis*. To all theſe I ſhall ſubjoin the Propoſal of an *Experimentum Crucis*, which may ſeem to determine whether the *Teſtes Fœmineæ* be truly the *Ovaria*, *viz.* open the *Abdomen* of the Females of ſome Kinds, and cut out theſe Teſticles, and this will determine whether this be abſolutely neceſſary for the Formation of Animals.

It is indeed difficult to conceive, how theſe Eggs ſhould be Impregnated, *per Semen Maris*, both becauſe there is no Connection between the Tube and the Ovary for its Tranſmiſſion; and for that Dr. *Harvey* could never diſcover any thing of it *in Utero*. But as to the laſt, M. *Leewenhoeck* has cleared that Difficulty, by the diſcovery of innumerable *Animalcula Seminis Maris in Cornubus Uteri*, and thoſe living for a conſiderable Time after Coition. And as to the former, we may either ſuppoſe that there is ſuch an Inflation of the *Tubæ*, or *Cornua Uteri Tempore Coitionis*, as makes them embrace the *Ovaria*, and ſuch an approach of the *Uterus* and its *Cornua*, as that it may eaſily tranſmit the Seed into the *Ovary:* Or elſe, that the *Ova* are Impregnated by the *Animalcules* after they deſcend into the *Uterus*, and not in the Ovary. The former ſeems probable, for this Reaſon, that at leaſt a whole cluſter of Eggs in a Hen will be Fecundated by one Tread of the Cock; now this Fecundation ſeems to be in the *Vitellary*, and not in the *Uterus*, as the Eggs paſs along from Day to Day; for it can hardly be ſuppoſed, that the *Animalcules* ſhould ſubſiſt ſo long, being ſcattered looſely in the *Uterus*, as to wait there for many Days, for the Fecundation of the Eggs as they paſs along. The latter Conjecture has this to ſtrengthen it, that the *Animalcules* are found to live a conſiderable Time in the *Uterus*, and that if they ſhould Impregnate the *Ova* in the *Ovary* it ſelf, the *Fœtus* would encreaſe ſo faſt, that the *Ova* could not paſs through the *Tubæ Uteri*, but would either burſt the *Ovary*, or fall down into the *Abdomen* from the Orifices of the *Tubæ*; and that from thence proceed thoſe extraordinary *Conceptiones in Abdomine extra Uterum*.

But M. *Leewenhoeck*, to weaken this Conſideration, about the Conception's being like unto an *Ovum* in the Womb, propoſes a Parallel between theſe *Animalcules* and *Inſects*, and inſinuates, that as the latter caſt their Skins, and appear of another Shape, ſo that the other which at firſt ſeem like *Tadpoles*, may caſt their outward Skin and then be round; and that this may be the Occaſion of the round Figure of the Conception in the Womb. To this it may be replied, that according to M. *Leewenhoeck*'s own Sentiment, the *Animalcules* cannot come forward if they do not find the *Punctum*, or proper Place for their Nouriſhment, to which it ſeems they muſt have ſome Adheſion. Now, the Conception *in Viviparis* is not faſtened unto the Womb for many Days, nor does adhere to any Point of it; ſo that it ſeems this rounder Body is not the *Animalcule* thus changed, after having caſt an outer Skin; but is rather the *Cicatricula*, or little Egg, into which the *Animalcule* has entered, as its *Punctum*, or place of Nouriſhment; elſe I do not ſee why they ſhould not be adhering to the Womb from the firſt Conception, or why, (as I have ſaid) many Hundreds of them are not conceived and formed together. n. 174. p. 1121.

2. I have oft reflected on the Figure of a *Mule*, that being an Animal produced by the Copulation of an *Aſs* and a *Mare*, the Extremities of the Body, the Feet, Tail, and Ears, and that black Croſs on the Back, reſemble that of the *Aſſes*. By this we may obſerve, that the Female contains in her By Sir J. Floyer, n. 259. p. 431.

Eggs the firſt Rudiments of the Animal of her own *Species*, and that of the Impregnation only changes ſome of the Extremities into a reſemblance of the Male. This ſeems to contradict our new Diſcoveries; for, if the Male ſupplies the *Animalculum*, the *Fœtus* muſt always be of the ſame Species as the Male; if the Female ſupply it, of her Kind; whereas Monſters are obſerved to be a mixture of both Species.

CXXVI. *Papers of leſs general uſe Omitted.*

n.77.p.3004 QUæries concerning *Vegetable Excreſcences*, and the *Inſects* bred in them, by Dr. *Liſter*.

n.249.p.50. 2. Several *Inſects* found near *Colcheſter*, by Mr. *Dale*.

n.8.p.137. 3. Prodigious Swarms of *Locuſts* in *Ukrania*: Extracted from M. *de Beauplan*'s *Deſcription of the Countries of* Poland, and M. *Thevenot*'s *Voyages Pt.* 1.

n.72.p.2171 4. Some general Inquiries concerning *Spiders*, by Dr. *Mart. Liſter*.

n.77.p.3002 5. *Queries* concerning *Tarantula*'s, by Dr. *M. Liſter*.

n.105.p.96, 99. 6. Some general *Queries* concerning Land and Freſh-Water-Snails; and part of a *Table* of them, with their Figures, by Dr. *M. Liſter*.

n.222.p.322 7. An Account of ſeveral Rare and Curious Shells, to be met with in *Scotland*, by Sir *Rob. Sibbald*.

n.100.p.7002. 8. To prevent the Rot of *Sheep*, by giving them *Spaniſh Salt*; Extracted from Mr. *Boyle*'s *Uſefulneſs of Experimental Philoſophy*, *Tom.* 2. *p.* 15.

n.103.p.50. 9. Inquiries and Directions concerning *Sheep*, and to preſerve them, and to improve the Race of *Sheep* for *Hardineſs*, and for the fineſt *Drapery*, by Dr. *J. Beale*.

CXXVII. *Accounts of Books, Omitted.*

n.28.p.535. n.64.p.2078 n.77.p.2281 HIſtoriæ Generalis *Inſectorum*, *J. Swammerdami*, Pars Prima. *Ultrajecti*, 1699, 4*to*.

n.143.p.23. 2. *Johannes Goedartius* of Inſects, done into *Engliſh*, and methodiz'd; with the Addition of Notes, by *Mart. Liſter*, Eſq; 1682, in 4*to*.

n.166.p.838 *Joh. Goedartius* de *Inſectis*: cum Appendice ad *Hiſtoriam Animalium Angliæ*; à *Mart. Liſter*, M.D.

n.47.p.987. 3. *Marc. Malpighii* Diſſertatio Epiſtolica de *Bombyce*; *Regiæ Societati* dicata, *Lond.* in 4*to*.

4.

4. Inſtructions for the planting of White Mulberries; the breeding of n.5.p.8.
Silk-Worms; and the ordering of Silk in *Paris*, and the circumjacent Parts;
by M. *Iſnard*.

5. Experienze Intorno alla *Generatione* degl' *Inſetti*; fatte da *Franciſco Redi*, n.57.p.1175
Academico della *Cruſca*. In *Firenze*, 1668, 4*to*. *The Opinion of that* Au- n.75.p.2254
thor *concerning the Generation of* Inſects, *is here oppoſed*, *by Dr*. M. Liſter.

6. Ricreatione dell *Occhio* è della *Mente*, Nell' Oſſervation delle *Chiocciole*; n.156.p.507
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